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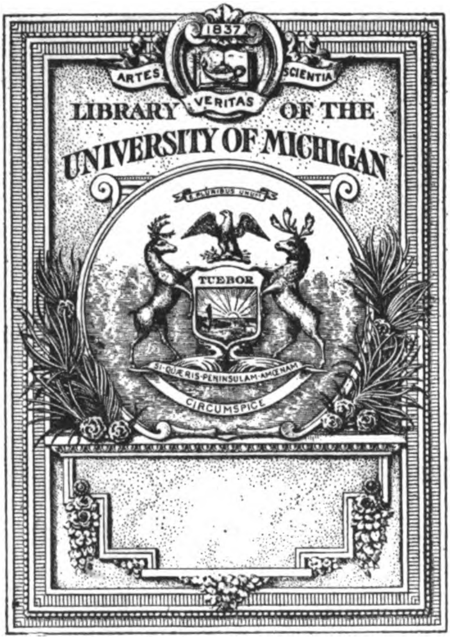

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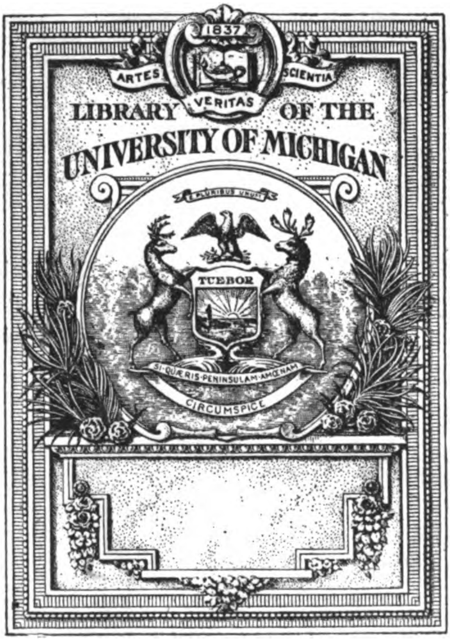
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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 55

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1920

ADVERTISEMENT.

The scientific publications of the National Museum consist of two series—Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prominent disseminations of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the fifty-fifth of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

William deC. Ravenel,
Administrative Assistant to the Secretary,
in charge of the United States National Museum.

October 13, 1919.

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THE ADULT TAENIOID
AND OF RELATED CARNIVORES IN NO

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INTRODUCTION AND SUMMARY.

The literature bearing on the subject of tapeworms parasitic in dogs and other carnivores is extensive, but because it is scattered in numerous papers the student of these forms is likely to experience considerable difficulty in the determination of specimens, particularly in the case of tapeworms from wild carnivores. Heretofore there has not been available a comprehensive discussion of the subject in a single paper.

The present paper includes descriptions of all the adult tapeworms of the superfamily Taenioidea known to occur in dogs, cats, and related carnivores in North America, together with species of the same superfamily not yet recorded as present in North America, but found in other parts of the world, and liable to occur in carnivores in this country. Supplementing the descriptions are keys for the determination of specimens, a list of hosts, and a bibliography.

The illustrations, whether original or copied, were made by Mr. W. S. D. Haines, artist of the United States Bureau of Animal Industry.

Lynx uinta is recorded as a new host for *Taenia taeniaeformis*. *Taenia macrocystis* is newly recorded for North America, having been collected from *Lynx ruffus* and *L. baileyi*. *Taenia pisiformis* (larval stage) is newly recorded from *Lepus californicus wallawalla*, *Sylvilagus floridanus mearnsii*, *S. auduboni baileyi*, and mountain beaver. *Taenia novella* Neumann, 1896, is regarded as synonymous with *T. pisiformis* instead of with *T. laticollis* as Lühe (1910) believed. *Taenia pisiformis* frequently shows more than the 8 to 10 lateral uterine branches commonly stated in the literature as characteristic of this species. As many as 14 may be present.

New hosts for *Taenia hydatigena* are the Bharral (National Zoo *novae*, *Alces alces*, *Ovis mexicana*, and *Odocoileus americanus*. Contrary to the statement commonly made in descriptions of this species placing the limits of the number of lateral uterine branches between 5 and 8, as many as 10, and even more, may be found

TAXONOMY AND MORPHOLOGY.

Phylum PLATYHELMINTHES.

Phylum diagnosis.—Worms which are flattened dorso-ventrally and are bilaterally symmetrical. No body cavity present. Digestive cavity present or absent; when present, incomplete—that is, with an initial mouth aperture but without a terminal anal aperture, except in the Nemertinea. Organs and systems of body embedded in a parenchymatous tissue. Muscular systems well developed. Nervous system consisting of an anterior nerve ring, surrounding the esophagus when the latter is present, and of longitudinal nerves, with ganglia, passing caudad and sending off branches. Skeletal system not represented, although calcareous corpuscles are commonly present in the body parenchyma of the Cestoda. These probably have little or no skeletal function. Circulatory system not represented. Respiration cutaneous. Excretory system consists of two or more longitudinal or coiled tubes, with terminal openings to the exterior and ultimate origins in nephridial flame-cells. Reproduction sexual or asexual, and development direct or with alternation of generations.

Class CESTODA.

Class diagnosis.—Platyhelminthes: Worms with external segmentation, exceptionally without, and with internal anatomy showing segmental arrangement and commonly arranged with reference to the external segmentation. At one end is a structure called the head, but variously regarded by writers as actually an anterior cephalic structure, or as a posterior pedal structure. This is essentially an organ of attachment and is provided with two suctorial grooves or bothridia, or with four more or less cuplike depressions or suckers. There may also be one to numerous crowns of hooks on a muscular apex or rostellum in forms with four suckers, and also on the suckers themselves in these forms. The body segments are smallest near the head. No digestive system present; food absorbed by osmosis through the body surface. Body parenchyma usually contains numerous calcareous corpuscles scattered through it. Nervous system consists of a nerve ring located in the head and sending two main nerve systems back on each side of the body or strobila, and of the nerves extending from the ring and the lateral nerve trunks and ganglia. The excretory system consists, commonly, of a dorsal and a ventral excretory vessel on each side of the strobila with a simple or elaborate set of vessels connecting the vessels of the same side or of opposite sides. The main longitudinal vessels terminate in openings in the posterior extremity of the strobila and receive waste matters poured in from canaliculi originating in flame-cells in the parenchyma. With rare exceptions, the strobila is hermaphroditic, the male and female sex organs being represented in each segment. The eggs, or, more properly, embryophores, develop in the segments to form an onchosphere armed with three pairs of hooks and surrounded by one or several membranes, or they are similar to fluke eggs, often with an operculum, do not contain an embryo when they escape from the segments, and later develop an onchosphere with a surrounding covering of cilia. Development always involves an alternation of generations, the intermediate stage, in the form of a bladderworm of some sort and with the developed head of the adult as the essential structure and a surrounding membrane of some sort as the incidental structure, developing in an intermediate host. This larval stage develops to the adult worm on ingestion by a suitable host.

Superfamily TAENIOIDEA Zwicke, 1841.

Synonym.—Cyclophyllidea van Beneden.

Superfamily diagnosis.—Cestoda: Head or scolex with four cup-shaped suckers which may exceptionally (Tetrabothriidae) bear auricular appendages, or exceptionally (Fimbriariidae) with a pseudoscolex in place of this scolex. Apical rostellum present or lacking. Suckers and rostellum may be armed with hooks or unarmed. Neck present or lacking. Strobila with well-developed segmentation, or exceptionally (Fimbriariidae) without division into segments. A single series of reproductive organs or a complete or incomplete double series, both male and female organs present in the same segments except in *Dioicocestus* where the strobilae are, respectively, male or female. Genital pores usually present and marginal, exceptionally ventral (Mesocestoididae), or lacking (Aporina). Testes usually numerous, occasionally as few as two, and in medullary portion of segment. Ovary more or less bilobed. Yolk gland compact, usually single and located near the median line. So-called shell-gland between ovary and yolk gland. Uterus without special opening for the discharge of eggs to the exterior, except that rarely a secondarily formed aperture may be present. Onchosphere with one or several membranes and without operculum. Larval stages in vertebrates or invertebrates. Adults in the alimentary canal of vertebrates.

Type-family.—Taeniidae Ludwig, 1886*a*.

In limiting the scope of this paper to a consideration of the taenioid cestodes, there have been excluded from consideration the carnivore tapeworms belonging to the Proteocephalidae and the Diphyllobothriidae. The only species of Proteocephalidae reported from carnivores is *Ophiotaenia punica* (Kholodkovski, 1908) La Rue, 1911. This species was described from the dog by Kholodkovski (1908) as *Taenia punica*, but the present writer (Hall, 1910) pointed out that this should be transferred to the genus *Proteocephalus* and that it was presumably not a true parasite of the dog, but had been ingested by the dog in eating the true host, some fish, reptile, or batrachian. In his revision of the Proteocephalidae, La Rue (1911) created the new genus *Ophiotaenia* for the reptilian cestodes of that family, and transferred this species to the new genus. This species is evidently not to be considered as a parasite of carnivores and nothing would be gained so far as concerns the purposes of the present paper by a description of its morphology. The presence of follicular yolk glands in the lateral fields is one feature which distinguishes the Proteocephalidae from the Taenioidea.

The omission of the Diphyllobothriidae from this paper is of more importance than the omission of the Proteocephalidae. Species belonging in this group have been reported from carnivores in North America and material of the sort is available to the writer for study, but a casual examination of the material indicates that it would require more time for adequate study than can be given at present. This family is relatively much less important than the superfamily Taenioidea covered in this paper. Members of the Diphyllobothriidae are characterized by the presence of a rosette-shaped uterus which has a special aperture in the midventral line for the discharge of eggs.

The keys given deal with each taxonomic group, from families to the species of a given genus, separately. At the end of this paper is a key covering the species of all genera involved.

KEY TO THE FAMILIES OF TAENIOIDEA.

1. Genital pores located on the ventral surface near the median line. Eggs in gravid segments enclosed in a single thick-shelled egg capsule.
MESOCESTOIDIDAE, p. 59.

Genital pores lateral. Eggs in gravid segments contained in a uterus or in numerous egg capsules.. 2

2. Usually large forms. Genital pores irregularly alternate. Rostellum usually well developed and usually armed with a double crown of hooks, rarely with a single (?) crown of hooks or unarmed. Suckers unarmed. Uterus with a median stem and lateral branches. Eggs thick shelled—i. e., embryo surrounded by a thick embryophore...........TAENIIDAE, p. 5.

Usually small forms. Genital pores single or double; if single, regularly or irregularly alternate. Rostellum present or absent; if present armed with one to numerous rows of hooks. Suckers armed or unarmed. Uterus saclike and persistent or with one or several parauterine organs to which the eggs pass in the final stage of development. Eggs with thin transparent shells (i. e., embryo surrounded by thin transparent embryophores).
HYMENOLEPIDIDAE, p. 61.

Family TAENIIDAE Ludwig, 1886*a*.

Synonyms.—Taeniadae Baird, 1853*a*; Taeniodea Diesing of Goldberg, 1855*a*; Taeniadea Carus, 1863; Teniadae Perrier, 1897*a*.

Family diagnosis.—Taenioidea: Rostellum usually well developed, rarely rudimentary, and usually armed with a double crown of hooks composed of a circlet of large hooks and a circlet of small hooks, the large and small hooks arranged alternately; rarely with a single (?) circlet of hooks or unarmed. Suckers unarmed. Gravid segments longer (that is, along the longitudinal axis of the strobila) than broad (that is, along the transverse axis of the strobila). A single set of reproductive organs in each segment with the genital pores irregularly alternate. Testes numerous. Ovary bilobed, or may be regarded as two ovaries. Uterus with a median stem and lateral branches and without an opening to the exterior for the escape of the eggs.

Type-genus.—*Taenia* Linnaeus, 1758.

Subfamily TAENIINAE Stiles, 1896*b*.

Synonyms.—Taeniea Goldberg, 1855*a*; Cystotaeniae Claus, 1876; Taenianae Railliet, 1896.

Subfamily diagnosis.—Taeniidae: Usually large species. Gravid segments usually considerably longer than broad. Scolex with rostellum and usually armed with a double crown of hooks, rarely with a single (?) circlet of hooks or unarmed. Genital pores irregularly alternate. Testes usually very numerous, mostly in the lateral portions of the median field bordered by the longitudinal excretory canals and to a less extent in the median portion of this field. Ovary, shell-gland, and yolk-gland in the posterior portion of the median field, distal from the head. Uterus with a median stem from which develop lateral branches, the structure suppressing the genital glands, wholly or partly, in gravid segments. Of the four longitudinal excretory canals, usually only the ventral are readily visible in gravid segments. Egg shell thin, with or without filaments, usually disappears after a time; embryophore thick and radially striate. Intermediate larval stage a bladderworm of the cysticercus, coenurus, or echinococcus type, occurring in herbivorous or omnivorous animals. Adult stage a strobilate worm in carnivora or omnivora.

Type-genus.—*Taenia* Linnaeus, 1758*a*.

KEY TO THE GENERA OF TAENIINAE.

1. Strobila less than 1 centimeter long and composed of a head and 3 segments, only one of the segments being gravid at a time. Lateral uterine branches often quite indistinct. Yolk-gland globular. Larval stage an echinococcus with thick laminated wall, and developing brood capsules containing the larval scolices...*Echinococcus*, p. 56.

Strobila at least several centimeters long and composed of a head and numerous segments, from 10 to hundreds, with a number of segments usually gravid at one time. Lateral uterine branches usually distinct, at least in early stages of formation. Yolk-gland posterior of ovaries and elongate or triangular, with one side parallel to the posterior margin of the segment. Larval stage a bladderworm with thin walls, and never containing brood capsules______ 2.

2. Handle of large hook usually sinuous; vagina usually shows a reflexed loop in the vicinity of the longitudinal excretory canals. Larva a coenurus—i. e., a bladderworm with a thin wall containing numerous scolices, and occasionally daughter bladders, but never brood capsules____*Multiceps*, p. 39.

Handle of large hook usually not sinuous; vagina straight or curved in the vicinity of the longitudinal canals, but without a reflexed loop at this point. Larva a cysticercus—i. e., a bladderworm containing one scolex. *Taenia*, p. 6.

It appears difficult at the present time to write a key that will differentiate between the strobilate forms of the genus *Taenia* and those of the genus or subgenus *Multiceps*. This is not surprising. A coenurus for a larval stage may be regarded as a localized mechanical device for reproductive purposes and need not be expected to exert any noticeable effect on the strobilate morphology. It would naturally be expected that species of this genus would show relationship, but it would not necessarily follow that there would be a notable departure in structure from that of the parent genus, *Taenia*.

Genus TAENIA Linnaeus, 1758*a*.

Synonyms.—*Tenia* Scopoli, 1777; *Hydatigena* Goeze, 1782*a*; *Megocephalos* Goeze, 1782*a*; ?*Pseudoechinorhynchus* Goeze, 1782*a*; *Finna* Werner, 1786*a*; *Vesicaria* Mueller, 1787*a*; *Hydatula* Abildgaard, 1790; ?*Haeruca* Gmelin, 1790*a*; *Hydatis* Blumenbach, 1797; *Cysticercus* Zeder, 1800*a*; *Alyselminthus* Zeder, 1800*a*; *Halysis* Zeder, 1803*a*; *Cisticercus* Rudolphi, 1805*a*; *Physchiosoma* Brera, 1809*a*; *Finna* Brera, 1809*a*; *Goeziana* Rudolphi, 1810*a*; *Hydatigera* Lamarck, 1816; *Fischiosoma* delle Chiaje, 1825*a*; *Trachelocampylus* Frédault, 1847*b*; *Arhynchotaenia* Diesing, 1850*a*; *Halisis* Goldberg, 1855*a*; *Acanthotrias* Weinland, 1858*a*; *Cystotaenia* Leuckart, 1863; *Neotenia* Sodero, 1886*a*; *Neotaenia* Braun, 1894*a*; *Cysticerkus* of authors; *Cystizerkus* of authors.

Generic diagnosis.—Taeniinae: Rostellum distinct and armed with a double crown of hooks, or, exceptionally, with a single (?) crown of hooks. Strobila composed of from 10 to hundreds of segments. Usually large forms. Larva a cysticercus in mammals; adult strobila in meat-eating mammals.

Type-species.—*Taenia solium* Linnaeus. 1758*a*.

KEY TO THE SPECIES OF TAENIA.

1. Rostellum with a single circlet of hooks of rose-thorn shape. .... *Taenia monostephanos*, p. 38.

   Rostellum with a double crown of hooks of conventional shape, i. e., with a relatively long handle .... 2.

2. Large hooks 60 to 74 in number; 320 to 355 μ long; the large hooks arranged alternately nearer to the center of the rostellum and farther from it, forming, in effect, 2 circlets of large hooks .... *Taenia macrocystis*, p. 13.

   Large hooks not over 60 in number .... 3.

3. No neck. Large hooks 380 to 420 μ long; hooks 26 to 52 in number, well-developed sphincter vaginae .... *Taenia taeniaeformis*, p. 9.

   Neck present, or if absent, large hooks 38 to 60 in number, no sphincter vaginae .... 4.

4. No neck. Large hooks 38 to 60 in number; 380 to 420 μ long. .... *Taenia laticollis*, p. 8.

   Neck present. Large hooks not over 294 μ long .... 5.

5. Large hooks 225 to 294 μ long. Small hooks deeply bifid. Testes extend posterior of the vitellarium. Vas deferens originates in a vesicula seminalis .... *Taenia pisiformis*, p. 22.

   Large hooks not over 220 μ long .... 6.

6. Guard of small hook twisted so that its flat surface tends to lie in the plane of the blade and handle .... *Taenia brachysoma*, p. 21.

   Guard of small hook not so twisted .... 7.

7. Head acorn-shaped with hooks far anterior of the suckers. Mature segments approximately square .... *Taenia balaniceps*, p. 16.

   Head not acorn-shaped and hooks not far anterior of the suckers. Mature segments distinctly broader than long .... 8.

8. Large hooks 95 to 140 μ long .... *Taenia brauni*, p. 19.

   Large hooks 148 μ long or more (species of *Multiceps* will run down to here with a range of 135 to 180 μ) .... 9.

9. Gravid uterus with 20 to 25 lateral branches on each side of the median stem. Vagina crosses the ovary on the pore side in some segments. .... *Taenia ovis*, p. 32.

   Gravid uterus with not over 10 lateral branches on each side. Vagina does not cross the ovary on the pore side of segments .... 10.

10. Large hooks 148 to 170 μ long. Genital papilla very large and prominent, practically as long as the margin of the segments. Vagina does not form a crescent near segment margin. Gravid segments without a median longitudinal groove terminating in a posterior notch. .... *Taenia krabbei*, p. 36.

    Large hooks 170 to 220 μ long. Genital papilla small and not prominent. Vagina forms a sort of crescent by dilation and curvature near lateral margin of segment. Gravid segments with a median longitudinal groove terminating in a notch posteriorly .... *Taenia hydatigena*, p. 28.

In the above key the distinction between *Taenia taeniaeformis* and *Taenia laticollis* is not well drawn. As a matter of fact, it appears impossible to draw any adequate distinction. All the described specimens of *T. laticollis* appear to have been based on immature specimens, and the descriptions of the genitalia with their topography, so essential in present-day specific concepts, have never been published. It is an open question in the writer's mind whether there is a distinct species, *T. laticollis*, or whether *T. laticollis* is a synonym of *T. taeniaeformis*. So far as the descriptions are concerned, and in view of the host records from Felidae, including the lynx, there is, if anything, more likelihood that it is a synonym.

TAENIA LATICOLLIS Rudolphi, 1819*a*.

Specific diagnosis.—Taenia: Head spherical to club-shaped, about 1 to 1.22 mm. in diameter. Rostellum cylindrical to conical, and 600 to 700 μ in diameter, sharply circumscribed at its base. A crown of 38 to 60 hooks, the large hooks (?) 380 to 420 μ long and with a blade only slightly curved, the handle slightly wavy, and the guard rounded conical in outline with a slight bulge on the side toward the blade. The small hooks (fig. 1) are 150 (?) to 183 μ long with a blade even less curved than that of the large hook, the handle thick and stumpy, rounded oblong in shape, and only slightly longer than the thick, rounded conical guard. The suckers have a diameter of 340 to 400 μ and are quite prominent. There is no neck, body segmentation beginning immediately back of the head and with no diminution in diameter. The first segments are short, later becoming square and finally oblong and longer than broad with a maximum diameter of 2 mm. The length of strobilae observed is 50 to 95 mm. Genital pores irregularly alternate and prominent.

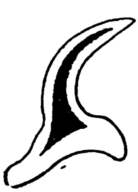
FIG. 1.—TAENIA LATICOLLIS. SMALL HOOK. ×150. AFTER LÜHE, 1910.

Male genitalia.—Not described.

Female genitalia.—Not described.

Hosts.—*Lynx lynx* (*Felis lynx*), *Lynx canadensis.*

Location.—Intestine.

Localities.—Europe, (?) United States.

Life history.—Unknown.

The above description has been compiled from Rudolphi (1819*a*), Diesing (1850*a*), Leuckart (1856*a*), and Lühe (1910, p. 697). Diesing repeats Rudolphi's description, Leuckart had some new material, while Lühe has reexamined Rudolphi's types, without, however, adding more than a few details to our knowledge. Lühe thinks that *Taenia novella* Neumann, 1896*f*, is probably identical with *T. laticollis*, but the presence of a distinct neck in *T. novella* and the shape, size, and number of hooks are all features that relate it to *T. pisiformis*, as Neumann noted in describing his new species. Leuckart states that the hook sizes are almost exactly those of *T. taeniaeformis*, and the figures in the specific diagnosis are made on the basis of this statement. None of the described material has been fully developed, so the important genital structures are unknown.

Stiles and Hassall (1894*d*) record this parasite from *Lynx canadensis* and note the presence of the specimens in the Army Medical Museum, but they give no further data as to where it was collected or by whom determined, probably because there was no record of these facts. It would require a very careful examination before anyone would be safe in saying that a tapeworm collected from *Lynx canadensis* on the American continent was identical with the imperfectly known *Taenia laticollis* from the European lynx, and the presence of this tapeworm in North America must be regarded as questionable.

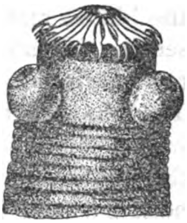

FIG. 2.—TAENIA TAENIAEFORMIS. HEAD VIEWED FROM THE SIDE. × 15. AFTER NEUMANN IN RAILLIET, 1893*a*.

TAENIA TAENIAEFORMIS (Batsch, 1786) Wolffhügel, 1911.

Synonyms.—Vermis vesicularis muris Hartmann, 1695*b*; *Fasciola muris hepaticae* Roederer, 1762*a*; *Taenia hydatigena* Pallas, 1766, part; *Vermis vesicularis teniaeformis* Bloch, 1780*a*; *Taenia collo brevissimo* Bloch, 1782*a*; *Taenia serrata* Goeze, 1782*a*; *Hydatigena taeniaeformis* Batsch, 1786; *Cysticercus fasciolaris* Rudolphi, 1808*a*; *Taenia crassicollis* Rudolphi, 1810*a*; *Taenia teniaeformis* (Bloch, 1780*a*) Stiles and Stevenson, 1905*a*. (For additional synonyms see Stiles and Stevenson, 1905*a*.)

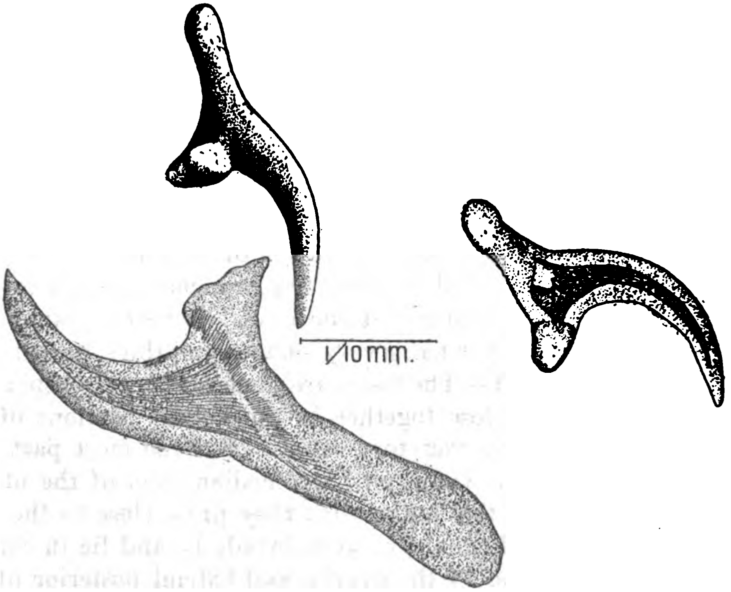

FIG. 3.—TAENIA TAENIAEFORMIS. LARGE AND SMALL HOOKS.

Specific diagnosis.—Taenia: Head thick, cylindrical anteriorly (fig. 2), and 1.7 mm. thick. The rostellum is short and armed with a double crown of 26 to 52 hooks. The large hooks (fig. 3) are 380 to 420 μ long. They have a blade of rather slight curvature; a handle which maintains a generally straight direction except at its distal extremity where it curves dorsad, and with a dorsal swelling near its middle and another smaller dorsal swelling at its union with the blade; and a guard with a tendency to bifid structure and presenting in lateral view parallel borders proximally and a conical termination distally. The small hooks (fig. 3) are 250 to 270 μ long. They have a blade of moderate curvature; the handle is straight with a slight enlargement distally, the enlargement curved dorsad; the guard enlarges just beyond its point of attachment, forming a neck between the enlargement and the attachment, and then terminates in a conical distal structure. The suckers are very prominent, being set on the cylindrical head at an angle pointing forward and outward. There is no neck, segmentation beginning directly posterior of the suckers and the initial segments being as broad as or broader than the head. The strobila attains a length of 15 to 60 cm. and a maximum width of 5 to 6 mm. The anterior segments are very short, the following are cuneiform, and the terminal are elongate, 8 to 10 mm. long by 5 to 6 mm. wide. Mature segments are wider than long and only terminal gravid segments are longer than wide. Calcareous corpuscles are numerous and oval. The parenchyma at times shows numerous rather large areas that fail to stain with carmine. The genital papilla is in the middle of the lateral margin, or anterior of the middle, is flat and inconspicuous, and is elongated along the longitudinal axis of the strobila. The transverse excretory canal is a single tube in the median portion of the strobila, but at its union with the ventral canal it forms two branches which pass dorsally and ventrally and surround the dorsal excretory canal (fig. 4). The dorsal excretory canal is very sinuous and thick walled.

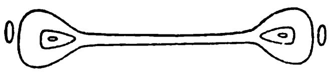

FIG. 4.—TAENIA TAENIAEFORMIS. DIAGRAM SHOWING THE TRANSVERSE EXCRETORY CANAL ENCIRCLING EACH DORSAL CANAL. AFTER LOVELAND, 1894.

Male genitalia (fig. 5).—The testes are numerous, oval or spherical in shape, and are set close together in the lateral portions of the median field close to the excretory canals. For the most part they leave a clear field in the vicinity of the median stem of the uterus, but may extend across this anteriorly; they press close to the field occupied by the genital canals, or even invade it, and lie in contact with the lateral portions of the ovaries and extend posterior of the ovaries but not quite to the vitellarium. The vas deferens is very much looped in a dense mass of closely approximated coils along the transverse and longitudinal axis of the strobila, and apparently originates at some distance from the median stem of the uterus on the pore side of the segment. The cirrus pouch is slender, frequently curved in gravid segments, and is difficult to observe in toto mounts.

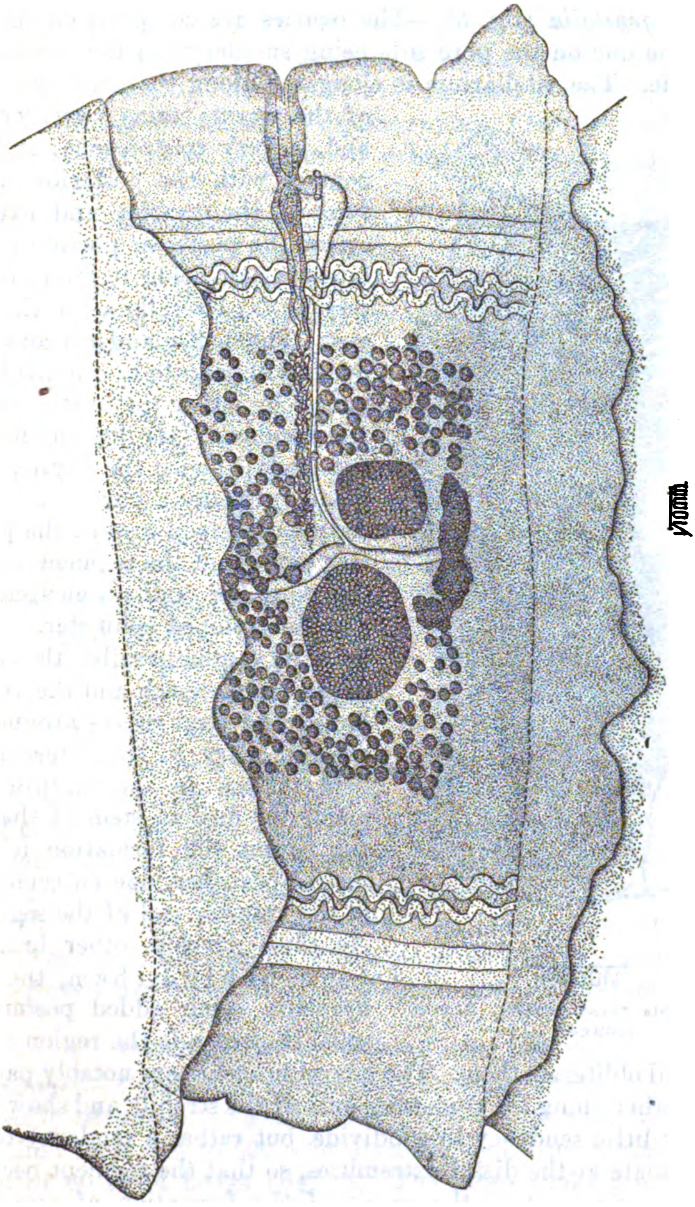

FIG. 5.—TAENIA TAENIAEFORMIS. MATURE SEGMENT. THE VAGINA PRESENTS THE APPEARANCE OF TERMINATING IN THE UTERUS.

In mature segments it attains a length of 430 to 475 μ and a maximum diameter around 70 μ; in gravid segments the cirrus pouch shortens and thickens, its length being 300 to 345 μ and its maximum diameter about 85 μ.

Female genitalia (fig. 5).—The ovaries are compact, circular in outline, the one on the pore side being smaller than the one on the aporal side. The vitellarium is elongated along the transverse axis of the worm, stains very densely, and is very conspicuous; it is in contact with the posterior curvature of the ovaries and extends across the posterior portion of the interovarian field; it does not extend as far laterally as do the ovaries. The shell-gland is inconspicuous and appears to be commonly obscured by either the ovaries or the vitellarium. Near its union with the genital sinus, the vagina commonly presents a curve or even a conspicuous loop toward the posterior portion of the segment, and at this point the vagina is encircled by a well-developed sphincter. From here the vagina parallels the course of the cirrus pouch and the vas deferens and then curves around the nearest ovary to the interovarian field. Even in the mature segments the median stem of the uterus begins the formation of two lateral branches, one on each side, at the anterior end of the segment. As these develop, other branches form behind them, the new branches being added posteriorly until they invade the region of the ovaries and obliterate them. The lateral branches are notably parallel to one another along the transverse axis of the strobila and show comparatively little tendency to subdivide, but rather a tendency to become sacculate at the distal extremities, so that the segment becomes filled with eggs, not as the result of the formation of numerous branches and the anastomosis of these branches, but as the result of the sacculation of the main lateral branches and especially of their distal extremities (fig. 6). The eggs are spherical and 31 to 37 μ in diameter.

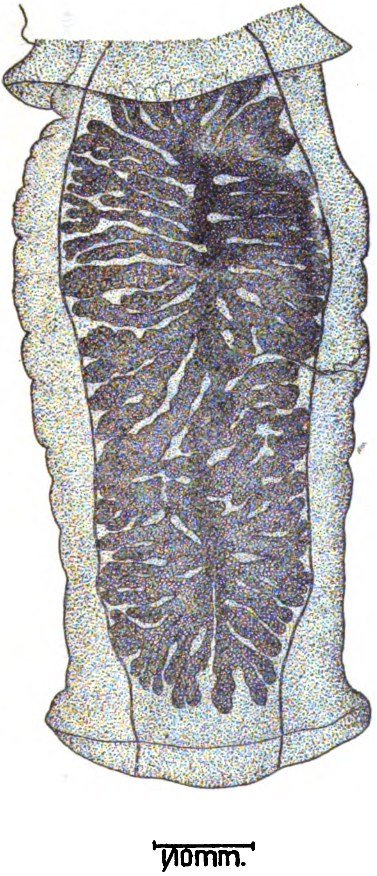

FIG. 6.—TAENIA TAENIAEFORMIS. GRAVID SEGMENT.

Hosts.—Primary: *Felis catus* (*F. domestica*), *F. maniculata*, *F. macroura*, *F. concolor*, *F. melivora*, *F. onca*, *F. mitis*, *F. tigrina*, *F. eyra*, *F. sylvestris* (*Catus sylvestris*), *Lynx uinta* (*Lynx uenta*), *Mustela erminea* (*Putorius erminea*). Secondary: *Mus musculus*, *Epimys rattus alexandrinus* (*M. rattus alexandrinus*, *M. tectorum*), *Epimys norvegicus*, *E. rattus rattus*, *Microtus arvalis* (*Arvicola arvalis*), *A. amphibius* (*A. amphibia*), "*Lemmus terrestris*," *Ondatra zibethica* (*Fiber zibethicus*), *Talpa europaea*, *Plecotus auritus*.

Location.—In small intestine of primary hosts. In liver of secondary hosts.

Localities.—Germany, Austria, Italy, France, England, Denmark, Iceland, Persia, Japan, United States.

Life history.—Eggs developed by the adult worm in the intestine of the primary host pass out and are ingested by the secondary host in contaminated food or water. In the digestive tract of the secondary host, the embryo escapes from the shell and makes its way to the liver, where it develops into the larval stage or bladderworm, commonly known as *Cysticercus fasciolaris*. This bladderworm is characterized by the presence of a very small caudal bladder or vesicle filled with fluid and a very long strobilate connection between this caudal bladder and the head. When the cysticercus is ingested by the primary host, the caudal bladder digests off and new segments are formed back of the existing strobilate portion, thereby developing into the strobilate tapeworm.

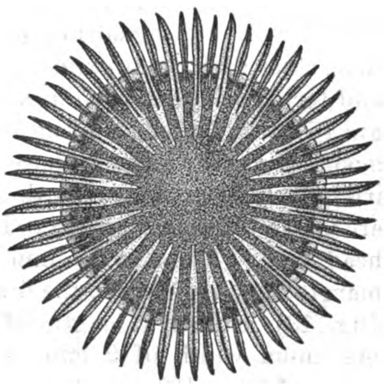

FIG. 7.—TAENIA MACROCYSTIS. HOOK CIRCLET VIEWED FROM THE FRONT. × 60. AFTER LÜHE, 1910.

The record from *Lynx uinta* in the above list is new. It should be noted that Lühe (1910) states that an examination of Diesing's South American cestodes, on which some of Diesing's records of *T. taeniaeformis* are based, did not disclose a single specimen of this worm.

TAENIA MACROCYSTIS (Diesing, 1850a) Lühe, 1910.

Synonym.—*Cysticercus macrocystis* Diesing, 1850*a*.

Specific diagnosis.—*Taenia:* Head 1.25 to 1.6 mm. in diameter. Rostellum from 515 to 690 μ in diameter and armed with a double crown of 60 to 74 hooks (fig. 7). The large hooks are alternated with the small in the customary manner, but in addition every other large hook is set a little closer to the center of the hook circlet than is the case with the remaining large hooks, with the result that the hook crown is arranged in one circlet of small hooks and two circlets of large hooks. This alternating arrangement of the large hooks is also observed in a lateral view of the head (fig. 8). The large hooks are 320 to 365 μ long. When the head is viewed from the front, showing the dorsal edge of the hooks, the large hooks are an elongate spindle shape, with a slight constriction along the middle portion. The blade and the handle attain their maximum thickness of 27 μ at their middle points, diminishing to 20 μ near the guard. From the lateral view (fig. 9) the large hooks present a blade with a moderate curve; a handle which is very variable in outline; it may be continuous dorsally with the straight line of the blade, and be almost straight, with a very slight undulation and a small enlargement at the end, this end tending to bend slightly in the ventral direction, or it may narrow to a rather acute tip and have a smooth or knobbed outline; and a guard that is somewhat triangular in outline or in some cases with the proximal portion presenting almost parallel sides and terminating distally in a triangular portion. The small hooks are 180 to 200 μ long. From the lateral view they present a blade of moderate curve; a thick, short handle curving dorsally; and a thick irregularly triangular guard. The suckers are not prominent and are 290 to 350 μ in diameter. The neck is somewhat smaller than the head and is 600 μ to 1.3 mm. long, measuring from the posterior margin of the suckers to the first trace of segmentation. The strobila (fig. 10) attains a length of 12 cm., a maximum width of 2 mm., and is composed of 90 to 100 segments. The genital pore lies near the middle of the segment and is very prominent. The dorsal excretory canal lies lateral of the plane of the ventral canal. The ventral canal is in the ventral portion of the segment and not merely ventral of the dorsal canal. The transverse canal connects the two ventral canals in the usual way. Youngest segments about 750 μ wide. About the eightieth segment, the maximum width occurs, segments being 2.2 mm. wide and 2.5 mm. long. The largest segments are 7 mm. long and 1.5 mm. wide. The genital primordia are visible about 1.5 mm. back of the head in the median portion of about the twentieth segment. The cirrus pouch and vagina lie between the dorsal and ventral excretory vessel and the longitudinal nerve is ventral of the cirrus pouch and vagina. The calcareous corpuscles are 19 by 13 μ in diameter.

FIG. 8.—TAENIA MACROCYSTIS. LATERAL VIEW OF HEAD. × 42. AFTER LÜHE, 1910.

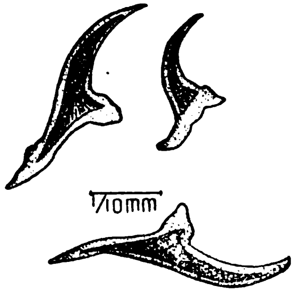

FIG. 9.—TAENIA MACROCYSTIS LARGE AND SMALL HOOKS.

Male genitalia.—The testes are comparatively few in number and are oval, the long axis paralleling the transverse axis of the strobila;

they lie in the lateral portion of the median field and cross the median field anteriorly; they appear to cross the field of the vas deferens and vagina at times, and extend close to the ovaries laterally as a rule, occasionally occurring posterior of the lateral portion of the ovaries; they do not lie so near the dorsal transverse musculature as in *Taenia taeniaeformis*. The vas deferens is very much looped, but pursues a fairly straight course from a point near the median stem of the uterus, on the pore side of the segment to the cirrus pouch. The cirrus pouch is very long and narrow and extends from the median border of the ventral excretory canal across both canals; it is 300 to 345 μ long and 35 to 60 μ wide.

Female genitalia.—The ovaries are elongated along the transverse axis of the strobila and inclose, usually, an oval to round interovarian field; the individual branches of the ovary are only moderately compact; the ovaries are of the same size, or the one on the aporal side may be slightly larger. The vitellarium is elongated along the transverse axis of the worm in contact with the posterior curvature of the ovaries and extends about as far laterally as do the ovaries. The shell-gland is obscured or inconspicuous. The vagina comes in from the genital pore in a long straight line and makes a very slight curve around and close to the nearest ovary. The uterine stem begins its initial development in the posterior portion of the segment, widening to fill the interovarian field and sending branches posterior of the ovaries. In the gravid segments (fig. 11) there are on each side 8 to 15 lateral branches, relatively short and themselves branching. In the last segments the main branches are amalgamated at the base. The egg is oval, 34 to 38 μ by 25 to 27 μ in diameter, with a shell 4.5 μ thick.

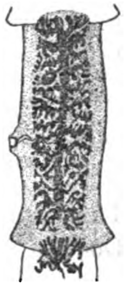

FIG. 11.—TAENIA MACROCYSTIS. GRAVID SEGMENT. × 5.5. AFTER LÜHE, 1910.

Hosts.—Primary: *Felis tigrina*, *F. yagouaroundi* (*F. jaguarundi*), *F.* sp., *Galictis* sp., *Lynx ruffus* (*L. rufa*), *L. baileyi*. Secondary: *Sylvilagus brasiliensis* (*Lepus brasiliensis*).

Location.—Intestine of primary host: Free in body cavity or encapsuled in the liver, in the region of the kidney or between the back muscles in the secondary host.

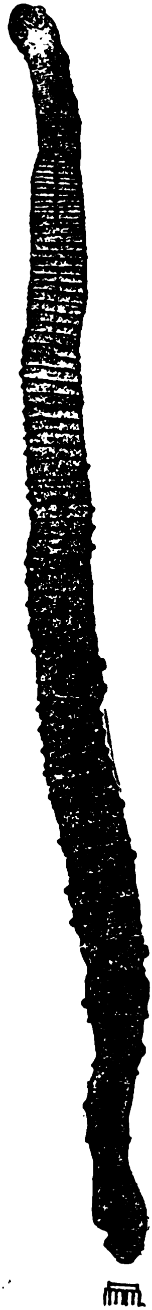

FIG. 10.—TAENIA MACROCYSTIS. ENTIRE STROBILA.

Localities.—Brazil, Paraguay, United States (North Carolina; Boulder, Colorado).

Life history.—The eggs produced by the strobilate tapeworm in the intestine of the primary host pass out and are ingested on food or in water by the secondary host where they develop to form the intermediate larval stage or bladderworm, known as *Cysticercus macrocystis* and very similar to *Cysticercus fasciolaris.* On ingestion of this bladderworm by the primary host in preying on the secondary host, the terminal vesicle digests off while the head and its strobilate connection with the bladder develops attached segments and so forms the strobilate worm.

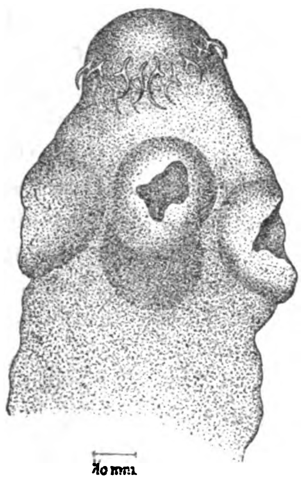

FIG. 12.—TAENIA BALANICEPS. HEAD. AFTER HALL, 1910.

The material recorded here from the United States is in the collection of the United States Bureau of Animal Industry. That from *Lynx ruffus* was collected by Doctors Hassall and Graybill from a lynx sent from North Carolina to the National Zoological Park at Washington, District of Columbia, and that from *L. baileyi* was collected at Boulder, Colorado, by Dr. Max Ellis.

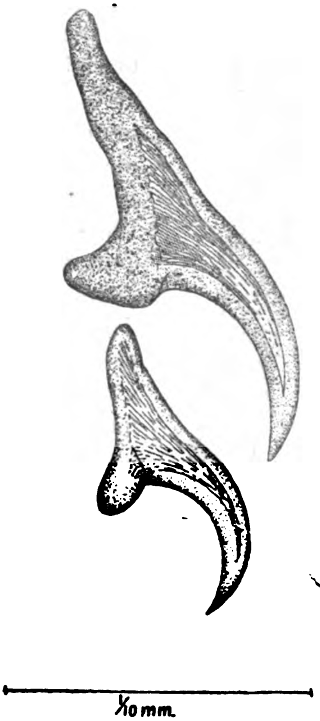

FIG. 13.—TAENIA BALANICEPS. LARGE AND SMALL HOOKS. AFTER HALL, 1910.

TAENIA BALANICEPS Hall, 1910.

Specific diagnosis.—*Taenia:* Head acorn-shaped (fig. 12), 735 μ long by 534 to 753 μ wide. Rostellum rounded and prominent, 307 μ in diameter, and armed with a double crown of 28 to 32 hooks, of which the larger are easily lost. The hooks are set far forward of the suckers. The large hooks (fig. 13) are 145 μ long. They have a blade of moderate curvature; the handle tapers toward its distal extremity; the distal extremity, which is not enlarged, curves slightly dorsad, and in lateral view the ventral outline is slightly convex, while the dorsal outline presents a slight median swelling and another slight swelling at the union of the blade the blade at the point of union with the blade. The small hooks

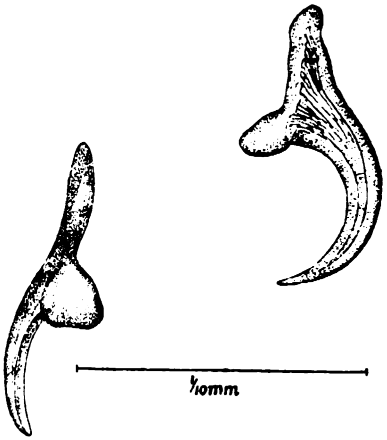

FIG. 14.—TAENIA BALANICEPS. SMALL HOOKS. AFTER HALL, 1910.

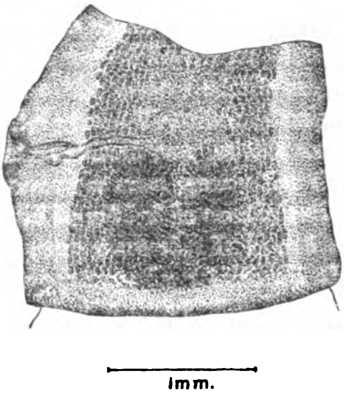

FIG. 15.—TAENIA BALANICEPS. MATURE SEGMENT. AFTER HALL, 1910.

(figs. 13 and 14) are 93 to 98 μ long. They have a strongly curved blade; the handle is short and thick and may be straight or present a slight curvature dorsad at its distal extremity; the guard is rather oval in lateral outline. The suckers are round, the bulb of the sucker being 215 to 265 μ in diameter. The neck is distinct and rather long, the maximum length being about 1.2 mm. from the posterior margin of the suckers to the first distinct segmentation. The strobila may attain a length of over 24 cm. Mature segments (fig. 15) are approximately square in outline and are about 2 mm. long by 2 to 2.5 mm. wide. Gravid segments (fig. 16) are 5.5 to 10.5 mm. long and 2 to 4 mm. wide. The genital canals pass out to the genital pore between the dorsal and ventral longi-udinal excretory vessels and either orsal or ventral of the main nerve unk. The transverse excretory nal is very large and tends to lie between two adjacent segments r than along the posterior border of the segments. The pri-

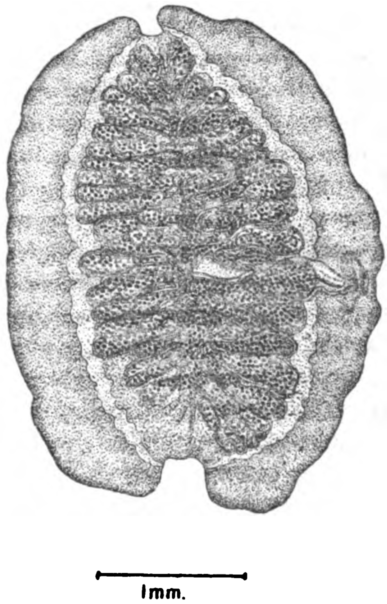

FIG. 16.—TAENIA BALANICEPS. GRAVID SEGMENT. AFTER HALL, 1910.

mordia of the genital organs appear a short distance back of the head; the testes, genital canals, shell-gland, and the main trunk of the uterus are clearly defined before the ovaries and yolk-gland can be detected. The genital pores are irregularly alternate and are especially prominent in segments full of developing eggs, where they may have an antero-posterior diameter of 480 µ, or about one-third the segment length. Calcareous corpuscles abundant, of variable size and shape, and with a maximum diameter of 20 µ.

Male genitalia.—The testes are commonly oval, with long axis paralleling that of the strobila (fig. 15), and are principally confined to two bands along the median side of the longitudinal excretory canals. A narrow band of testes crosses the extreme anterior margin of the segment, connecting the two lateral fields and leaving a large space clear of testes, frequently approximately square in outline, between this band, the lateral testicular fields, and the ovaries. The lateral testicular fields extend to the lateral margin of the ovaries, frequently encroaching on the field of the vas deferens and vagina, and are prolonged posterior of the ovaries to the yolk-gland. The vas deferens arises near the plane of the median stem of the uterus, either on the pore side or the aporal side. At the plane of the ventral excretory canal, or just lateral of this, the vas deferens opens into a tubular cirrus pouch 300 to 370 µ long, with an average length of 355 µ. The diameter of the cirrus pouch varies considerably, the maximum diameter being about 110 µ. There is no vesicula seminalis present. The length of the cirrus varies from 418 to 518 µ, with a maximum diameter of about 33 µ and a lumen diameter of about 8 µ.

Female genitalia.—The ovaries are elliptical to crescentic in outline with their longitudinal axes paralleling that of the strobila, and inclose an oval to oblong interovarian fields. The vitellarium is elongated in the transverse axis of the strobila and extends a slight distance between the ovaries but not lateral of them. The shell-gland is very close to the vitellarium. The vagina swings in a wide curve from the genital pore around the nearest ovary and opens into a small receptaculum seminis in the neighborhood of the shell-gland. The uterus originates as a median stem, and develops branches of unusual form. These branches are club-shaped and so closely approximated and at times so united that the ultimate result resembles a lobed sac (fig. 16). In many cases one uterine lobe extends over the longitudinal excretory canals in the vicinity of the genital pore. The eggs are ovoid in shape, are 29 to 37 µ by 27 to 33 µ in diameter, the average being 35 to 31 µ. The shell is about 4 µ thick.

Hosts.—Primary: *Canis familiaris*, *Lynx ruffus maniculatus* (*Lynx rufus maculatus*). Secondary: Unknown.

Location.—Intestine of primary host.

Localities.—Nevada (Fallon); Southern New Mexico.

Life history.—Unknown.

The uterine structure is of the type found in such tapeworms as *T. taeniaeformis* and indicates that the lynx is probably the normal host, as the dog is certainly an accidental or occasional host. On the other hand, the narrow neck in *T. balaniceps* is quite different from the thick neck or the absence of a neck in many tapeworms parasitic in the Felidae.

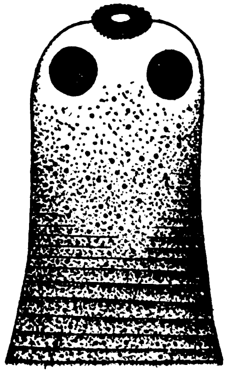

FIG. 17.—TAENIA BRAUNI. ANTERIOR EXTREMITY. × 20. AFTER SETTI, 1897.

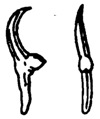

FIG. 18.—TAENIA BRAUNI. LARGE HOOKS. × 100. AFTER SETTI, 1897.

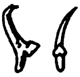

FIG. 19.—TAENIA BRAUNI. SMALL HOOKS. × 100. AFTER SETTI, 1897.

TAENIA BRAUNI Setti, 1897b.

Specific diagnosis.—*Taenia:* The head (fig. 17) is slightly flattened in the dorso-ventral plane and attains a maximum diameter of a little over 1 mm. The rostellum is not strongly developed and bears a double crown of 30 hooks. The large hooks (fig. 18) are usually 130 to 140 μ long, occasionally only 95 to 100 μ long. The blade is of slight curvature; the handle is straight, of slightly wavy outline, and distinctly marked off dorsally at its union with the blade; the guard is conical in lateral view and tends to be bifid to a slight extent. The small hooks (fig. 19) are usually 85 to 90 μ long, occasionally only 70 to 75 μ long. The blade is of moderate curvature; the handle is short and curved, the convexity of the curve being on the ventral side; and the guard is shaped like that of the large hook. The suckers are round and are comparatively small, with a maximum diameter of 300 μ. The neck is of about the same diameter as the head and is short, segmentation being clearly marked 2 mm. from the anterior extremity of the body. The strobila attains a maximum length of 15 to 18 cm. and a maximum width of 6 mm. The anterior segments are 100 μ long and 1.3 mm. wide. In the middle of the strobila (fig. 20) the segments are still transversely elongated, being 1.5 mm. long and 6 mm. wide. The terminal gravid segments (fig. 21) are 5 to 6 mm. long and 3.5 mm. wide. The segments are rectangular and do not present a serrate

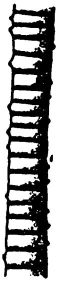

FIG. 20.—TAENIA BRAUNI. MEDIAN PORTION OF STROBILA. ACTUAL SIZE. AFTER SETTI, 1897.

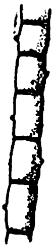

FIG. 21.—TAENIA BRAUNI. POSTERIOR PORTION OF STROBILA. ACTUAL SIZE. AFTER SETTI, 1897.

edge on the margin of the strobila. The segments are dense owing to their thickness and the abundance of calcareous corpuscles. The genital papillae are in the middle of the segments and are prominent. The longitudinal excretory vessels are sinuous and are 500 to 700 μ from the margin of the strobila on each side.

. *Male genitalia.*—The cirrus pouch is short (fig. 22), extending about half the distance from the lateral margin of the segment to the longitudinal canals and so perhaps (?) 250 to 350 μ long. It opens anterior of the vagina.

Female genitalia.—The vagina extends in a straight line from the genital pore toward the median line. The lateral branches of the uterus are small, numerous, and perpendicular to the median stem. They do not extend across the longitudinal excretory canals. The eggs are round and 35 to 38 μ in diameter.

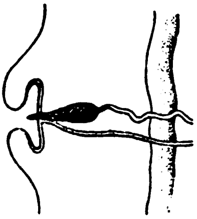

Fig. 22.—Taenia brauni. Region of genital pore. Diagrammatic. After Setti, 1897.

Host.—Primary: *Canis familiaris.* Secondary: Unknown.

Location.—In intestine of primary host.

Locality.—Eritrea.

Life history.—Unknown.

Setti states that this species does not present a true rostellum, but does bear the customary double crown of hooks. The rostellum is the distinct muscular bulb which provides the musculature for the movement of the hooks and of the apical sucker when this is present. Inasmuch as the efficiency of the hooks depends on their musculature, it seems inconceivable that a tapeworm should have a well-developed and functional crown of hooks and not have a rostellum. I have therefore modified Setti's statement, which seems to be based on a misunderstanding or misstatement of some sort, substituting the statement that the rostellum is not strongly developed. Other features of the description have been taken from Setti's illustrations, including the shape of the hooks and the apparent length of the cirrus pouch.

It is likely that this tapeworm, like *Taenia balaniceps*, is only accidentally parasitic in the dog, and that its usual host is some wild carnivore. Dogs are such common subjects of investigation for parasites the world over that while it is possible to overlook a dog tapeworm, as happened in the case of *Taenia ovis*, it is nevertheless unlikely that *T. brauni* is a customary parasite that has been overlooked.

Railliet and Henry (1915) state that the hooks in this tapeworm resemble those of the genus *Multiceps*. This is true, but the structure of the vagina differs from that which I have found in known species of the genus *Multiceps*, in that it does not present a reflexed loop near the longitudinal canals.

TAENIA BRACHYSOMA Setti, 1899c.

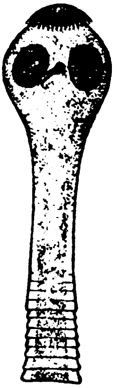

FIG. 23.—TAENIA BRACHYSOMA. ANTERIOR EXTREMITY. × 20. AFTER SETTI, 1899.

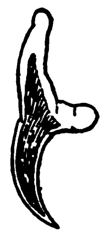

FIG. 24.—TAENIA BRACHYSOMA. LARGE HOOK. × 200. AFTER SETTI, 1899.

Specific diagnosis.—Taenia: Head (fig. 23) about 700 μ in diameter and more or less elongate piriform in shape. Rostellum prominent and bearing a double crown of 30 to 32 hooks. The large hooks (fig. 24) are 135 to 145 μ long. The blade has a rather slight curvature; the handle is slightly curved, at times irregularly so, with the convexity of the curve on the dorsal surface and meeting the similar curve of the blade in a distinct obtuse angle opposite the middle of the guard; the guard is thick, and in lateral view the sides of the guard are approximately parallel, the distal extremity being bluntly rounded. The small hooks (fig. 25) are 95 to 105 μ long. The blade makes a very sharp curve toward the axis of the handle and guard and then straightens out, its distal portion being roughly parallel to the axis of the handle and guard; the handle is very short and blunt, with a slight tendency to curve dorsally at the tip; the guard is rather broad, furrowed to show a trace of bifidity, and tends to be twisted so that the lateral axis lies in the plane of the blade and handle. The suckers are round and have a maximum diameter of 250 to 270 μ with a circular or elliptical aperture of about 150 μ. The neck is distinct, narrower than the head, with an average measurement of 300 to 400 μ and not exceeding 1 mm. long to the first distinct segmentation. The strobila (fig. 26) attains a maximum length of 10 cm. and a maximum width of 3 mm. The first segments are 40 to 70 μ long and 350 to 450 μ wide; 5 mm. back of the head they are 200 to 230 μ long and 600 to 900 μ wide; 1 cm. back of the head they are 240 to 260 μ long and 800 μ to 1 mm. wide; in the middle of the strobila they are 750 μ to 1.25 mm. long and 2.3 to 2.8 mm. wide; 2 cm. from the posterior extremity they are 1.25 to 1.7 mm. long and 2.5 to 3 mm. wide; the terminal segments are 2.5 to 3 mm. long and 2.3 to 2.5 mm. wide. There are 140 to 180 segments. The first segments are trapezoidal with projecting posterior angles forming a serrate strobila margin. The segments

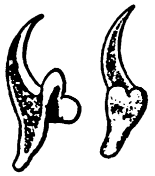

FIG. 25.—TAENIA BRACHYSOMA. SMALL HOOKS. × 200. AFTER SETTI, 1899.

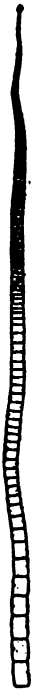

FIG. 26.—TAENIA BRACHYSOMA. ENTIRE STROBILA. ACTUAL SIZE. AFTER SETTI, 1899.

in the middle of the strobila are rectangular, almost as long as wide, and with the posterior angles less prominent and the strobila margin smoother than anteriorly. The posterior segments are almost quadrate, the last two or three longer than wide. Occasionally the middle segments are campanulate and a little longer than wide. Calcareous corpuscles are especially abundant in the anterior portion of the strobila. The small genital papilla is near the middle of segment. It is most distinct in segments in the middle of the strobila. The longitudinal excretory canals are about 500 μ from the lateral margin of the segments.

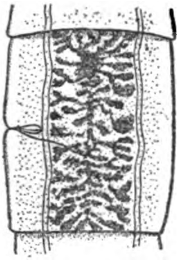

FIG. 27.—TAENIA BRACHYSOMA. GRAVID SEGMENT. ENLARGED. AFTER SETTI, 1899.

Male genitalia.—The aperture of the cirrus pouch is at the base of a genital sinus 100 to 170 μ long. The median extremity of the cirrus pouch is about at the plane of the longitudinal excretory vessels.

Female genitalia.—The uterus (fig. 27) occupies the median portion of the segments included between the longitudinal excretory canals. The median stem has 10 to 12 lateral branches on each side, approximately perpendicular to the median stem, and terminating distally in a variable number of smaller branches of various sizes, shapes, and positions. Developed embryophores are only found in the last four or five segments. The eggs are spherical and 32 μ in diameter.

Host.—Primary: *Canis familiaris.* Secondary: Unknown.

Location.—In intestine of primary host.

Locality.—Italy (Turin).

Life history.—Unknown.

In a general way the circumstances indicate that this tapeworm, like *Taenia brauni*, is also an accidental parasite of the dog.

Setti's statement that the guard of the small hook is twisted so that the lateral axis tends to lie in the plane of the blade and handle, has been noted by Ransom (1913) with the following comment: "Setti does not make it clear whether this twisted condition is invariably present. The small hooks of *Taenia hydatigena* commonly present a similar appearance after subjection to the pressure of a cover glass." This point is well taken. Tapeworm hooks are flexible structures, capable of considerable distortion under pressure or torsion, up to the limit of flexibility, at which point, of course, breaking occurs.

TAENIA PISIFORMIS (Bloch, 1780*a*) Gmelin, 1790*a*.

Synonyms.—*Vermis vesicularis pisiformis* Bloch, 1780*a*; *Hydatigena pisiformis* (Bloch, 1780*a*) Goeze, 1782*a*; *Hydatigena utriculenta* Goeze, 1782*a*; *Hydatigena cordata* Batsch, 1786*a*; *Hydatigena utricularis* Batsch, 1786*a*; *Vesicaria pisiformis* (Bloch, 1780*a*)

Schrank, 1788*a*; *Taenia serrata canis domestici* et *vulpis* Rudolphi, 1793*a*; *Cysticercus pisiformis* (Bloch, 1780*a*) Zeder, 1803*a*; "*Taenia serrata* Goeze" of most authors; *Taenia novella* Neumann, 1896*f*. (For additional synonymy see Stiles and Stevenson, 1905*a*.)

Specific diagnosis.—Taenia: Head (fig. 28) 1.3 mm. in diameter. Rostellum large and powerful, 515 to 640 μ in diameter, and armed with a double crown of 34 to 48 strong hooks. The large hooks (fig. 29) are 225 to 294 μ long. They have a strongly curved blade; the handle is very long and, observed from the side, usually has straight sides, gradually diverging distally to a blunt rounded termination, a truly club-shaped handle, which passes dorsally rather directly into the blade save for a short elevation dorsally, which is usually present at the union of the blade and handle; the guard is rather long, thickest in its median portion, thinning slightly at its union with the blade and handle, and terminating distally in a bluntly rounded cone. The handle and guard form a very obtuse angle. The small hooks (fig. 29) are 132 to 177 μ long. They have a strongly curved blade; the handle, viewed from the side, is thick and rather short, its sides distinctly or slightly curved and approximately parallel, the convexity of the curve being ventral, and terminating as a rule, in a bluntly rounded end distally; the guard is usually distinctly and often strongly bifid (fig. 30), the depth of the cleft varying, rather oval in

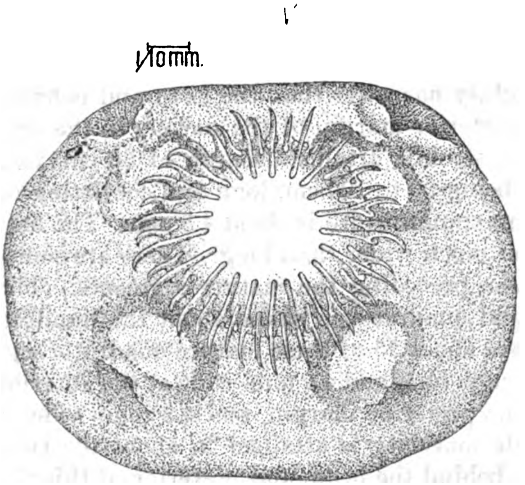

FIG. 28.—TAENIA PISIFORMIS. HEAD, VIEWED FROM THE FRONT.

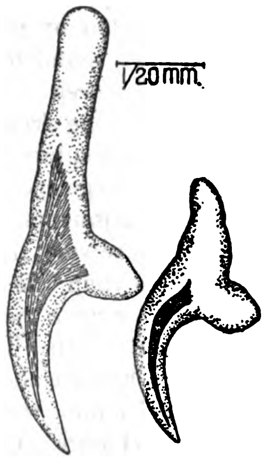

FIG. 29.—TAENIA PISIFORMIS. LARGE AND SMALL HOOKS.

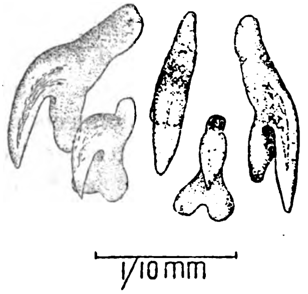

FIG. 30.—TAENIA PISIFORMIS. LARGE AND SMALL HOOKS AS SEEN IN A LATERAL VIEW OF THE HEAD.

outline when viewed from the side, and with a proximal protuberance toward the side of the blade. The lines of the handle and guard do not meet but are separated by a rather long interval, slightly to strongly convex in outline when viewed from the side. The distances from the distal extremity of the guard to the distal extremities of the blade and handle are very nearly equal. Viewed from the front the head (fig. 28) is approximately square with the suckers located at the corners and separated by relatively wide intervals from one another. The suckers are round to elliptical with a maximum diameter of 310 to 330 μ. The neck is but slightly narrower than the head and is 680 μ to 1.7 mm. long from the posterior margin of the suckers to the first distinct segmentation. The strobila attains a length of 60 cm. to 2 meters, average specimens being 90 to 100 cm. long and consisting of about 400 segments. The maximum width is about 4.8 mm. The first segments are very short and much wider than long. There are something less than 175 of these preceding the mature segments. The segments become mature and quadratic in shape about the hundred and seventy-fifth. There are about 25 of these mature quadratic segments. They are about 4.9 mm. long and 4.2 mm. wide at the anterior margin, 4.7 mm. wide at the posterior margin, and 4.8 mm. wide at the genital pore. Complete maturity is attained in about the two-hundredth segment, 25 cm. behind the head, and posterior of this the segments transform into gravid segments. There are 30 to 40 gravid terminal segments, making up almost half of the entire strobila, these segments attaining a length of 1 cm. and a width of 4 mm. The posterior angles of all segments are prominent, giving a characteristic serrate appearance to the strobila. The calcareous corpuscles are variable in shape and have a maximum diameter of 18 μ. The longitudinal excretory canals are about 640 μ from the lateral margin of the segment and 770 μ from the genital pore. The transverse excretory canal has the customary position in the posterior portion of the segment and connects with the ventral canal. The genital pores are irregularly alternate, commonly two in succession on one side and rarely as many as four to six in succession. The genital papilla is only moderately prominent and is located near the middle of the segment except in gravid segments where it frequently is distinctly posterior of the middle. The genital primordia are visible in toto mounts in the fifth to the twelfth segments back of the head.

Male genitalia.—The testes (fig. 31) are round or slightly elongated in outline and are 132 by 96 μ in diameter. There are about 400 to 500 in a segment, and they occupy nearly all the field included between the longitudinal excretory canals not actually occupied by other genital structures. In the posterior portion of the segment they fill the lateral fields clear up to the median stem of the uterus, leaving only little more than the width of the uterus free of testes in the median field, except in the region near the ovary where the clear field is a little wider. On the pore side of the segment they extend back to the vas deferens, the space between the vas and the vagina being free of testes, and then extend from the vagina on this side, and from the anterior margin of the segment on the aporal side, back to the posterior margin of the segment. They press between the loose lobes of the ovary and posterior and dorsal of the vitellarium. Aside from the space occupied by the median stem of the uterus and the field of the vas deferens and vagina, the only space free of testes is that between the ovaries. The testes are arranged in two strata, a dorsal and a ventral, some overlying others in frontal views. The vasa efferentia open into a distinct vesicula seminalis, 210 by 350 µ in diameter, located on the pore side of the median stem of the uterus. From the vesicula seminalis the vas deferens extends posteriorly parallel to the median stem of the uterus for a short distance and then curves toward the pore side of the segment. The vas deferens is very large, much looped and irregular, with the thick loops lying very close to one another. The cirrus pouch extends in from the margin of the segment to the plane of the ventral excretory canal, or very commonly to a point as much as 107 µ median of this plane, and is surrounded by a distinctive layer of cuboid cells. It is cylindrical or, rather, compressed elliptical in outline, with its maximum diameter in the middle. Maximum diameter, 130 to 140 µ; length, 460 to 800 µ.

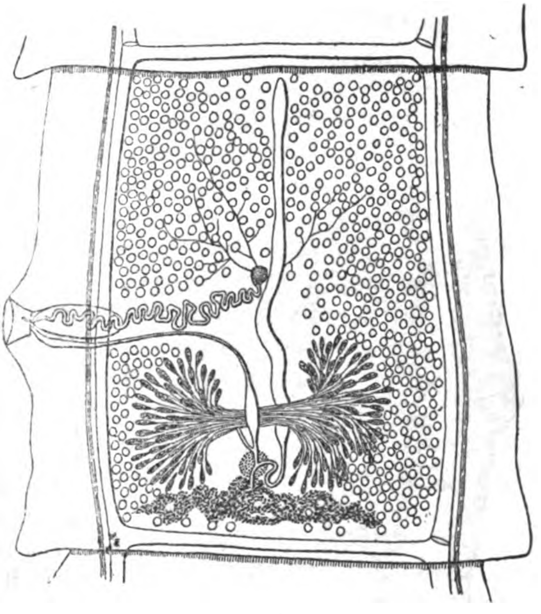

FIG. 31.—TAENIA PISIFORMIS. MATURE SEGMENT. ENLARGED. AFTER DEFFKE, 1891.

Female genitalia.—The ovaries (fig. 31) are somewhat reniform, the concavities of the two inclosing an oval interovarian field, and are of rather loose structure. They are very nearly equal in size. The vitellarium is very large, extending laterally past the ovaries, and forward to the posterior border of the ovaries and a short distance into the interovarian field. The shell gland is large and in frontal view of its posterior portion appears to be embedded in or overlaid by the portion of the vitellarium which projects into the interovarian field. The vagina extends in from the genital pore almost straight or somewhat inclined anteriorly and curves around the nearest ovary, forming the receptaculum seminis in the interovarian field. In gravid segments (fig. 32) the uterine stem is very long and bears on each side 8 to 14 lateral branches, which in turn send out secondary branches, these branches usually distinct or with only a slight tendency toward terminal fusion. The eggs are elliptical, 37 by 32 µ in diameter.

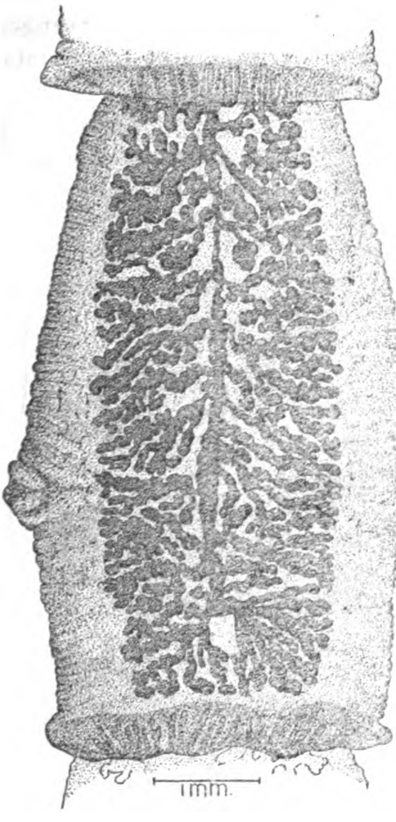

Fig. 32.—Taenia pisiformis. Gravid segment.

Hosts.—Primary: *Canis familiaris*, *C. latrans*, *C. nebracensis*, *Felis catus* (*F. domestica*), *F. tigris*, *Urocyon cinereoargentatus*, fox. Secondary: *Oryctolagus cuniculus* (*Lepus cuniculus ferus*, *L. c. domesticus*), *L. europaeus* (*L. timidus*), *L. timidus* (*L. variabilis*), *Sylvilagus brasiliensis* (*L. brasiliensis*), *S. floridanus mallurus* (*L. sylvaticus*), *L. californicus wallawalla*, *S. floridanus mearnsii* (*L. mearnsi*), *S. palustris* (*L. palustris*), *L. americanus*, *S. auduboni baileyi*, *S. nuttalli pinetis*, *Mus musculus*, mountain beaver.

Location.—In intestine of primary host. In liver, mesenteries, and free or attached in abdominal cavity of secondary host.

Locality.—More or less cosmopolitan.

Life history.—Eggs produced by the strobilate tapeworm pass out and are ingested in contaminated food or water by the primary host. The embryo is released in the digestive tract and bores its way into the liver, where it begins development as a bladderworm, commonly called *Cysticercus pisiformis*. Usually it develops to a certain point and then slips out of the liver and falls into the abdominal cavity, where it remains free for a time, ultimately becoming attached by an adventitious cyst to the mesenteries as a rule.

Of the above host records the following are new: *Lepus californicus wallawalla*, *Sylvilagus floridanus mearnsii*, *S. auduboni baileyi*, and mountain beaver. The records from *Lepus sylvaticus* by Stiles and Hassall (1894*d*) are covered in the above list by *S. f. mallurus*. Other American records are given by Welch (1890*a*), Curtice (1892*g*), Garrison (1911), Sommer (1896), Stiles and Hassall (1898*a*), Young (1908*a*), Ward (1895*a* and 1897*b*), Leidy (1855 and 1891*a*), and Hall (1913).

Taenia novella Neumann, 1896*f*, has been regarded here as a synonym of *Taenia pisiformis*. It has already been noted in the discussion of *Taenia laticollis* that Lühe (1910) has regarded *T. novella* as a synonym of *T. laticollis* and the reasons given for disagreeing with this view. Neumann's specimens had a globular piriform head, 1.12 to 1.22 mm. in diameter, with four prominent suckers of slightly oval contour, 400 by 340 µ in diameter, and with a slightly prominent rostellum with a central depression and bearing 40 to 42 hooks. The large hooks (fig. 33) are 250 to 260 µ long with a thin handle of undulant contour and a little longer than the blade. The small hooks are 150 to 155 µ long with a quite long handle and a broad cordiform guard. The neck is about 3 mm. long. Substantially all of the above is in agreement with the description of *Taenia pisiformis*, and the parts that are not in exact agreement are well within the limit of variation already known. The large hooks of *T. novella* are described as having a thin handle of undulant contour. An examination of the figure given by Neumann shows a handle which I would describe as thick, showing merely the inadequacy of such relative terms. The figure is very distinctly that of the large hook of *T. pisiformis*. The undulation in outline is very slight, much less than that found by Stevenson (1904) in his study of the variation of the hooks of *T. pisiformis*. Practically the same comments apply to Neumann's statement that *Taenia novella* has a long handle. His figures show that it is relatively longer and narrower than the usual handle in *T. pisiformis*, but it is well within the limits of variation shown for these hooks by Stevenson. His statement that the neck is 3 mm. long, is probably based on unmounted material, while the measurements I have given are based on stained mounts, and hence are due to the difference between a gross measurement and a microscopic measurement.

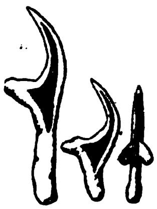

FIG. 33.—TAENIA NOVELLA. LARGE AND SMALL HOOKS. × 100. AFTER NEUMANN, 1896. REGARDED HERE AS T. PISIFORMI

Neumann had 23 specimens of *T. novella*, the largest specimen being 33 mm. long. This fact not only would influence the measurement of the neck, in all probability, but it suggests that the worms might have been in a host animal in which they had not come to maturity and in which they possibly never could mature. *Taenia pisiformis* is certainly not a normal parasite of the cat, but it might be an occasional parasite, developing to a certain stage at least. Dramard and Benoit-Bazille (1905) have recorded *T. pisiformis* from *Felis tigris*. [Since the above was written, Ackert and Grant (1917) have developed immature *T. pisiformis*, up to 22 mm. long, in kittens, by feeding *Cyst. pisiformis*.]

Some of the maximum measurements given in the specific diagnosis of this species are cited from Deffke (1891*a*), and in the writer's experience are much in excess of the usual maximum measurements. Stevenson (1904) has noted that some of Deffke's measurements are not substantiated by his illustrations. This is especially true of the measurements of the cirrus pouch.

In counting the testes in toto mounts, a count of 300 is apt to be obtained rather than 400 to 500, but this is probably due to the fact that the testes are in two strata and that some overlie others.

It is commonly stated that this species has 8 to 10 lateral branches on each side of the main uterine stem. In this case, as in the case of other species of tapeworms examined by the present writer, the number of lateral branches of the uterus may be larger. Stained and mounted specimens may show as many as 14 branches, exclusive of the terminal anterior and posterior digitations of the main uterine stem.

TAENIA HYDATIGENA Pallas, 1766.

Synonyms.—*Lumbricus hydropicus* Tyson, 1691*a*, pre-Linnaean; *Hydra hydatula* Linnaeus, 1767*a*; *Vermis vesicularis eremita* Bloch, 1780*a*; *Hydatigena orbicularis* Goeze, 1782*a*; *Taenia marginata* Batsch, 1786*a*; *Cysticercus tenuicollis* Rudolphi, 1810*a*. (For additional synonyms, see Stiles and Stevenson, 1905*a*.)

Specific diagnosis.—*Taenia:* Head variable in shape, reniform, spherical, cylindrical or truncated pyramidal with the square to oblong base of the pyramid constituting the rostellar face of the head, and with a head diameter of about 1 mm. Rostellum with a double crown of 26 to 44 hooks. The large hooks (fig. 34) are 170 to 220 μ long. They have a blade of moderate curvature; the handle, viewed from the side, has a rather sinuous contour, with its dorsal and ventral margins approximately parallel, and meets the blade dorsally in an obtuse angle; the guard is actually and relatively long, about 40 μ, and rather narrow, somewhat cylindrical proximally and terminating conically distally, the cylindrical portion sometimes slightly larger at its union with the conical portion, and the guard forming almost a right angle with the ventral outline of the handle. The small hooks are 110 to 160 μ long. They have a strongly curved blade; the handle, viewed from the side, is long, narrow, and curved, the convexity being on the ventral surface; the guard is long, narrow and cylindrical, viewed from the side, and is much expanded and cordiform to Y-shaped when viewed along the longitudinal axis of the blade. The suckers are situated at the angles of the head. They are relatively large, about 310 μ in the longest diameter, and are set rather close to one another. The neck is distinct or indistinct, according to the state of contraction, and is approximately 500 μ long from the posterior margin of the suckers to the first distinct evidence of segmentation. The strobila is from 75 cm. to 5 meters long, the average strobila being 2 meters long and consisting of 650 to 700 very thick segments. In such a strobila the short wide segments at the anterior portion of the strobila gradually become larger, but the mature segments are also wider than long. Mature segments begin about 50 cm. behind the head about the two hundred and seventy-fifth to the three hundredth segment. These segments are about half as long as wide, being 3.78 mm. long and 7.5 mm. wide. These are followed bv about 50 quadratic segments in which the uterus branches are forming and the genital glands undergoing atrophy. Gravid segments begin about the five hundred and eightieth to the six hundred and tenth segment, and are longer than wide, being 10 to 15 mm. long and 4 to 5 mm. wide. The lateral margins of the strobila are smooth and without serration, but the posterior margin of each segment is continued posteriorly over the anterior portion of the succeeding segment, forming an enveloping cuff. In the gravid segments there is a tendency, characteristic of the species, to show a median longitudinal furrow on the dorsal and ventral surfaces, the furrow terminating posteriorly in a notch. The genital papillae are near the middle of the lateral margins of the segments and are not at all prominent. The calcareous corpuscles are usually oval, with a maximum diameter of 20 μ. The longitudinal excretory canals are about 700 μ from the lateral margin of the segment.

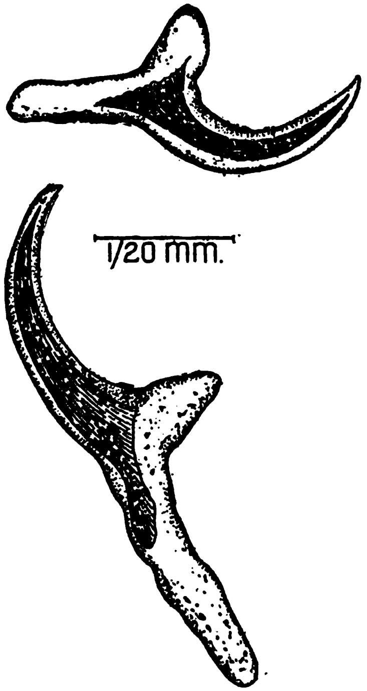

FIG. 34.—TAENIA HYDATIGENA. LARGE AND SMALL HOOKS.

Male genitalia.—There are about 600 to 700 relatively small testes (fig. 35), which are very thickly distributed in one plane and separated by a continuous sheet of parenchyma from the ovary and the vitelline gland. The testes extend close to the median stem of the uterus and the vas deferens and vagina, leaving little clear space about these free fields, but they leave a fairly wide, distinct, clear field about the ovaries and vitellaria and do not extend posterior of these. The vas deferens is without a vesicula seminalis and arises at a little distance from the median stem of the uterus on the pore side of the segment. The vas deferens is narrow and is looped in comparatively open loops. It is quite commonly pigmented. The cirrus pouch is cylindrical, 450 µ long and 130 µ wide.

Female genitalia.—The ovaries are approximately circular in dorso-ventral view, except for a flattening on the sides nearest one another, by virtue of which they bound an interovarian space of rectilinear outline. The ovary on the aporal side of the segment is distinctly larger than that on the pore side. The vitellarium has a very distinct and regular reticular structure. It is narrow and prolonged along the transverse axis of the worm and does not extend beyond the ovaries laterally or into the interovarian field anteriorly. The shell-gland is distinctly in the interovarian field and is not in apparent contact with the vitellarium. The vagina curves posteriorly from the genital cloaca and then anteriorly to the level of the excretory canals, forming a sort of crescent, which is widely dilated. From the excretory canals it extends straight in toward the median portion of the segment, paralleling practically the entire extent of the vas deferens, and then curving around the nearest ovary to the receptaculum seminis in the interovarian field. The vagina is not infrequently pigmented. In gravid segments (fig. 36) the uterine stem bears on each side few, 5 to 10, thick lateral branches, which in turn send out few thick secondary branches which remain fairly distinct

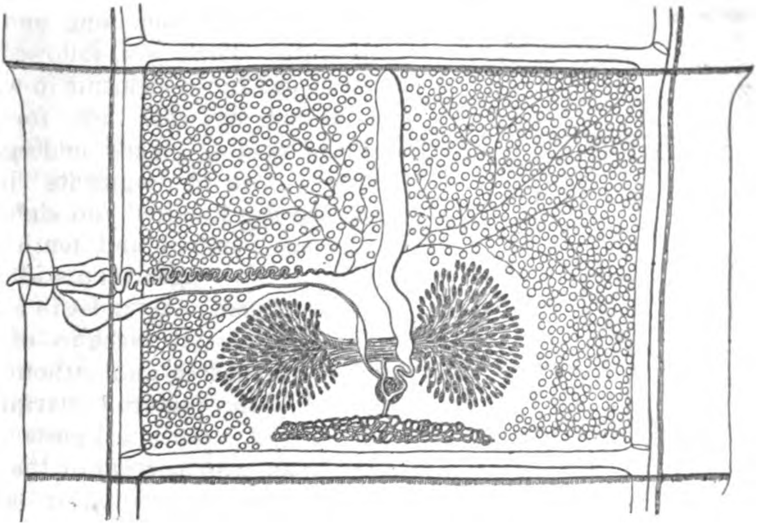

FIG. 35.—TAENIA HYDATIGENA. MATURE SEGMENT. ENLARGED. AFTER DEFFKE, 1891.

as a rule. The eggs are elliptical, 38 to 39 μ long and 34 to 35 μ wide. The shell is 4 μ thick.

Hosts.—Primary: *Canis familiaris*, *C. lupus*, *C. mesomelas*, saddle-backed jackal, (?) *Felis catus* (*F. domestica*). Secondary: *Bos taurus*, *Ovis aries*, *Sus scrofa*, *S. scrofa domestica*, *Capra hircus*, Duiker, Springbok, Rooi reebok, "*Simia faunus*," *Presbytis entellus* (*Semnopithecus entellus*), *Lasiopyga cynosura* (*Semnopithecus cynosurus*), *Lasiopyga mona* (*Cercopithecus mona*), *Lasiopyga sabaeus* (*C. sabaeus*), *Pithecus* species (*Macacus cynomolgus*), *Simia sylvanus* (*M. inuus*), *Papio maimon*, *Sciurus niger neglectus* (*S. cinereus*), *S. vulgaris*, *Ovis argali*, *O. musimon*, *Rupicapra rupicapra* (*R. tragus*), *Oryx beisa*, *O. leucoryx*, *Saiga tartarica*, *Gazella dorcas*, *Antidorcas euchore* (*G. euchore*), *Kobus ellipsiprymus*, *Mazama rufa* (*Cariacus rufus*), *Mazama nemorivaga* (*C. simplicicornus*), *Capreolus capreolus* (*C. caprea*), *Rangifer tarandus* (*Tarandus rangifer*), *Axis axis* (*Cervus axis*), *C. elaphus*, *Rusa unicolor* (*C. unicolor*), *Phachochoerus africanus*, *P. aethiopicus*, *Potamochoerus koiropotamus* (*P. porcus*), Bharrel, *Odocoileus hemionus* (*Cariacus macrotis*), *Rangifer terrae-novae* (*R. novae-terrae*), *Alces alces* (*A. machlis*), *Ovis mexicana*, *Odocoileus americanus* (*Cervus virginianus*), Columbia deer.

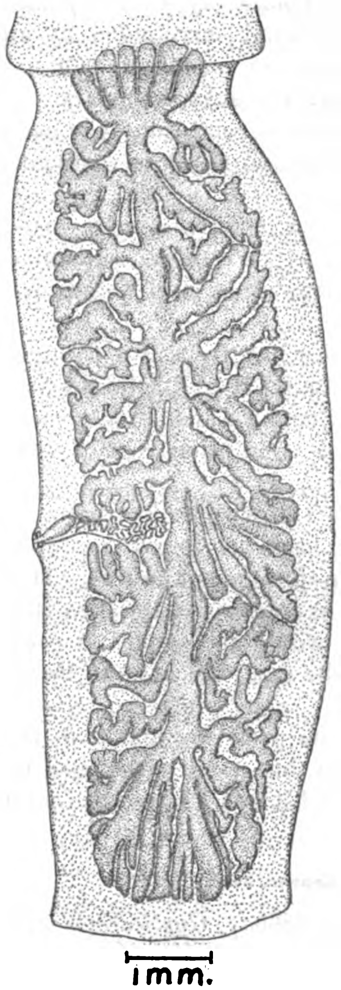

Fig. 36.—Taenia hydatigena. Gravid segment. After Ransom, 1913.

Location.—In small intestine of primary host. Imbedded in liver, or free or attached to viscera, and especially to mesenteries, in abdominal cavity of secondary host.

Locality.—Cosmopolitan.

Life history.—The eggs produced by the adult worm in the intestine of the primary host pass out and are ingested in contaminated food or water by the secondary host. In the digestive tract of the secondary host the embryo is liberated from its shell and bores its way into the liver, where it wanders around for a time, apparently following the course of the blood vessels and causing a condition resembling angioma. The embryos then develop in the liver to the bladderworm, called *Cysticercus tenuicollis*, and are either found adherent to the capsule of the liver, or, more commonly, they slip into the abdominal cavity and are commonly found surrounded by an adventitious cyst attached to the mesenteries or omentum. On ingestion of these bladderworms by the primary host in eating the secondary host, as would be the case under natural conditions, the head on the bladderworm attaches in the intestine and develops segments, forming the strobilate worm.

Of the hosts given above those not known to have been reported previously are the Bharrel, Columbia deer, *Odocoileus hemionus*, *Rangifer novae-terrae*, *Alces alces*, *Ovis mexicana*, and *Odocoileus americanus*.

Writers commonly state that this species has from five to eight lateral uterine branches, but I have often found 10 and believe a fair count in some cases would show more. Comment has already been made on the count of uterine branches in connection with *Taenia pisiformis*.

Stiles and Hassall (1912) note that this tapeworm has been reported for *Felis catus* (*F. domestica*). I have not found the reference in question and so am not in a position to comment on this. If it were backed up by such evidence as there is to support the idea that *Taenia novella* is really a dog tapeworm I would accept it. At present, and for the purposes of this paper, the case will have to be regarded as not proven.

The very striking median groove and its posterior notch on the gravid segments is figured by Stiles (1898), but is not mentioned by him. Deffke (1891*a*) apparently overlooked it and I have not found any mention of it.

TAENIA OVIS (Cobbold, 1869*a*) Ransom, 1913.

Synonyms.—Cysticercus ovis Cobbold, 1869*a; Cysticercus oviparIens* Maddox, 1873*a*; *Cysticercus cellulose* of Küchenmeister, 1878, in Küchenmeister and Zürn, 1878–1881*a* (misdetermination); *Cysticercus tenuicollis* of Chatin, in Railliet, 1885*a* (misdetermination); *Cysticercus oviparus* Leuckart, 1886*d*.

Specific diagnosis.—Taenia: The head is oblong, flattened in the dorso-ventral direction and elongated along the transverse axis, and is 800 μ to 1.25 mm. wide. The rostellum is well developed, 375 to 430 μ in diameter, and bears a double crown of 24 to 36 hooks. The large hooks (fig. 37) are 156 to 188 μ long, the average being 173 μ. The blade is of slight to moderate curvature; the handle is narrow, with its dorsal and ventral margins, viewed from the side, approximately parallel, usually quite distinctly wavy in outline but occasionally almost straight, and usually with a more or less well-marked convexity on the dorsal border near the union with the guard, the union, as a result, forming a more or less obtuse angle, while the other end of the convexity frequently terminates in a notch in the dorsal margin of the handle; the guard is at right angles to the blade and is roughly conical to elongate cordiform in lateral view, the maximum thickness being a short distance from the point of union and so forming a proximal neck. The small hooks are 96 to 128 μ long. The blade does not present a prominent concavity on its ventral surface, but it makes a sharp curve, amounting at times almost to a bend, and then straightens out with the point past the extended longitudinal axis of the handle; the handle is long, narrow. and tapering with a marked tendency, unusual in dog tapeworms, to turn ventrally at the distal extremity, and with the dorsal and ventral margins rather straight or only slightly wavy; the guard is united to the handle at an obtuse angle and is of approximately the same shape as that of the large hook, the guard at times showing a slight median ventral groove. The suckers are 270 to 320 μ in diameter and are set on at the corners of the oblong head. The neck is distinct, narrower than the head, 650 to 900 μ wide, varying in length according to the state of contraction, a specimen in a state of moderate contraction having a neck about 600 μ long from the posterior border of the suckers to the first distinct segmentation. The strobila is 45 to 110 cm. long, with a maximum width of 4 to 8.5 mm., and has a tendency to twist in the form of a spiral. The segments have convex lateral borders. Immature and mature segments are wider than long; gravid segments are longer than wide. Mature segments are 1.9 to 3.5 mm. long and 5.5 to 6.5 mm. wide Gravid segments attain a maximum length of 15 mm., the width varying with the state of contraction, from 3 to 5.5 mm. The genital papillae are very prominent, the entire lateral border on the pore side being much more sharply convex than on the aporal side. They are situated in the middle of the segment and in gravid segments may attain a diameter of over 1 mm. and an elevation of 750 μ

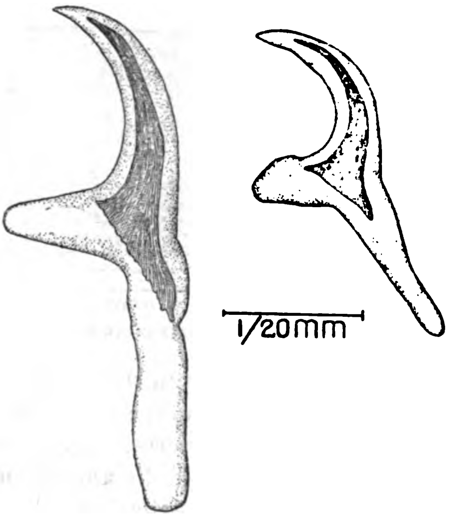

FIG. 37.—TAENIA OVIS. LARGE AND SMALL HOOKS.

Calcareous corpuscles are numerous in the neck and less so in the head.

Male genitalia.—There are about 300 testes visible in stained toto mounts. Near the middle of the segment they are scattering and are commonly elongated in the transverse axis of the worm (fig. 38); in that part of the median field adjoining the longitudinal canals they are crowded close together and appear to be of more irregular outline and looser texture. The testes decrease in number toward the median stem of the uterus, but only occasionally leave a narrow clear field at this point, two or three testes usually occupying this field. Along the lateral portion of the median field they form a confused mass which presses in on the ovaries laterally, but does not extend posterior of the ovaries or the vitellarium. The testes crowd close to the vas deferens and the vagina, leaving only a narrow free field in that region with an occasional testis occurring in this field. Anterior of the ovaries the testes leave a free semicircular space, the ends of the semicircle following approximately the antero-lateral borders of the ovaries. The vas deferens begins at a little distance from the median stem of the uterus on the pore side and extends to the cirrus pouch in a series of somewhat irregular loops, an occasional loop in some segments crossing the vagina. The cirrus pouch is 450 to 550 µ long, the inner end being near the outer margin of the ventral excretory vessel.

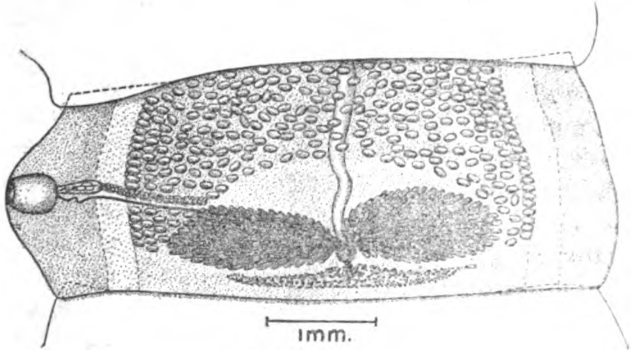

FIG. 38.—TAENIA OVIS. MATURE SEGMENT. AFTER RANSOM, 1913.

Female genitalia.—The ovaries (fig. 38) are of notably loose and open texture, the one on the aporal side of the segment being the larger and frequently extending a projecting portion anteriorly and medially. The ovaries are elongated in the transverse axis of the segment and are concave on the median face, inclosing as a rule a rather circular interovarian space. The vitellarium is a very open reticular structure, elongated in the transverse axis of the segment, not extending as far laterally as the ovaries and very little or not at all between the ovaries. The reticulations of the vitellarium are also uniformly elongated along the transverse axis of the segment. The shell gland is small and distinct, and not in apparent contact with the vitellarium. The vagina has usually a slightly sinuous course in the lateral field of the segment, but after crossing the longitudinal excretory canals it extends medially in a rather straight or but slightly curved course and either barely clears the anterior margin of the nearest ovary or crosses the anterior portion of this ovary, a quite unusual and distinctive feature. In gravid segments (fig. 39) the median uterine stem bears on each side 20 to 25 lateral branches, which in turn send out numerous secondary branches which frequently fuse. The eggs are oval, 30 to 34 μ long by 24 to 28 μ wide.

Hosts. — Primary: *Canis familiaris*. Secondary: *Ovis aries*, *Capra hircus*.

Location.—In small intestine of primary host. Embedded in the heart, voluntary muscles, esophagus, lungs, walls of stomach (?), and kidneys (?) of secondary hosts.

Localities.—England, France, Germany, Algeria, German Southwest Africa, New Zealand, and the United States.

Life history.—Eggs developed by the adult worm in the intestine of the primary host pass out and are ingested in contaminated food or water by the secondary host. In the digestive tract of the secondary host the embryos escape and bore their way into the muscles and other suitable portions of the host's anatomy and finally come to rest and develop to the bladderworm stage, called *Cysticercus ovis*. On the ingestion of these larvae by the primary host the head of the bladderworm develops segments and forms the strobilate tapeworm.

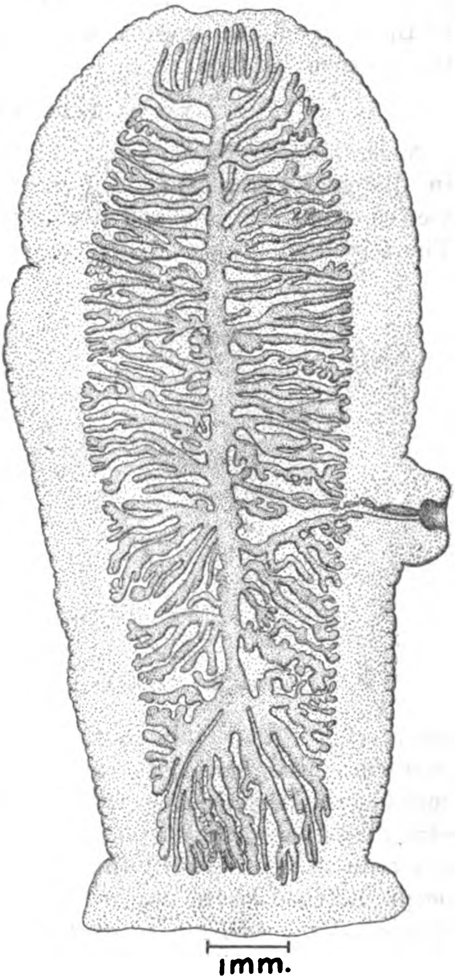

FIG. 39.—TAENIA OVIS. GRAVID SEGMENT. AFTER RANSOM, 1913.

The evidence to the effect that the larvae of this parasite are widely distributed over the world and that they have been overlooked in meat inspection in this and other countries indicates that this is a fairly common tapeworm of dogs, and possibly of other carnivores, that has somehow been overlooked until Ransom (1913) called attention to it. It is quite possible that it has been confused with *T. hydatigena*, though the macroscopic and microscopic differences between these forms are considerable and very evident when once pointed out. The distinctive feature in this species is the crossing of the ovary by the vagina on its way from the segment margin to the interovarian field.

TAENIA KRABBEI Moniez, 1879c.

Specific diagnosis.—Taenia: The head is very small, about 500 µ in diameter, presenting a generally spherical appearance when viewed from the side and a square outline when viewed en face. The rostellum bears a double crown of 26 to 34 hooks. The large hooks (fig. 40) are 148 to 170 µ long. The blade is of moderate curvature; the handle is strikingly polymorphic, either straight, curved in a simple curve, with the convexity of the curve dorsal or ventral, or wavy, may have its sides approximately parallel or may taper or thicken toward the distal extremity, may be slightly or deeply notched on the dorsal border or not at all notched; the guard is generally cordiform to oval. The small hooks are 85 to 120 µ long. They have a blade of strong curvature; the handle is tapering, straight or somewhat curved, but in either case with a tendency to curve dorsally at the tip; the guard is cordiform to oval in lateral view and has usually a slight median groove. The suckers are inconspicuous. The neck is narrow and distinct and appears to be about 1 mm. long in the cotype specimen. The strobila (fig. 41) attains a length of over 26 cm. and a maximum width of over 1 cm. All segments, except the few (7 or 8) terminal gravid segments are very much wider than long, segments 8 mm. wide being about 1

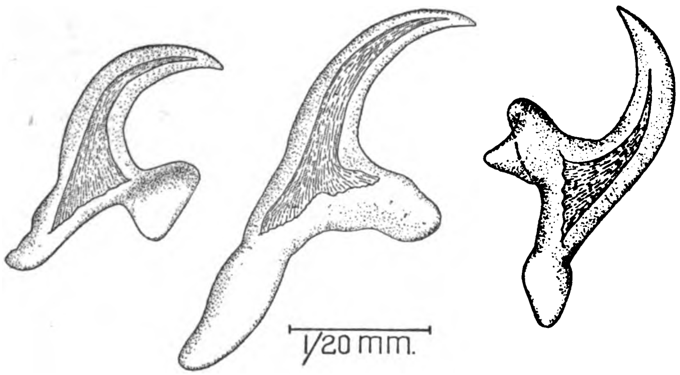

FIG. 40.—TAENIA KRABBEI. LARGE AND SMALL HOOKS.

mm. long. Terminal gravid segments are 4 to 5.5 mm. long and 3.5 to 4.5 mm. wide. The genital papillae are extremely large, occupying practically the entire lateral margin of a segment, except in the terminal gravid segments, and attaining a diameter of about 1 mm.

Male genitalia.—The cirrus pouch is elongate piriform and apparently does not extend to the lateral excretory canals.

Female genitalia.—Vagina often pigmented. Median stem of the uterus has about 10 lateral branches on each side. Eggs relatively small.

Hosts.—Primary: *Canis familiaris.* Secondary: *Rangifer tarandus* (*Tarandus rangifer*).

Location.—In intestine of primary host. In voluntary musculature of secondary host.

Locality.—Iceland, Alaska.

Life history.—Eggs produced by the adult worm in the intestine of the primary host pass out and are ingested by the secondary host in contaminated food or water. In the digestive tract an embryo is released and makes its way to the musculature and heart of the host animal. Here it develops to the larval stage, known as *Cysticercus tarandi.* On the ingestion of this bladderworm by the primary host, the caudal vesicle digests and the head develops segments forming the strobilate worm.

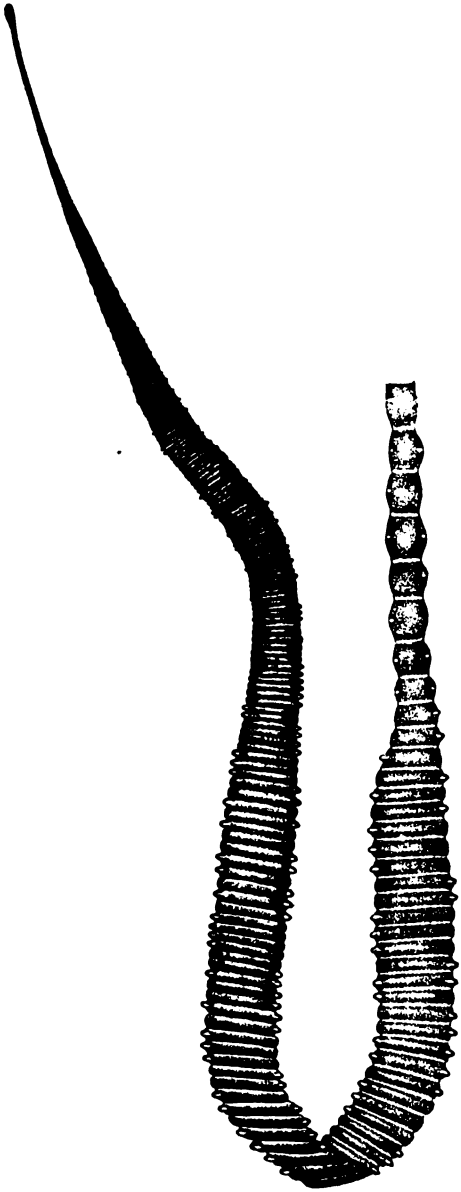

FIG. 41.—TAENIA KRABBEI. ENTIRE STROBILA. ACTUAL SIZE. AFTER MONIEZ, 1880.

The internal anatomy of this tapeworm is not described in detail. In connection with the presence of the parasite in reindeer in Alaska, Doctor Ransom, chief of the Zoological Division of the United States Bureau of Animal Industry, will later publish a study supplying a description of the internal anatomy.

TAENIA MONOSTEPHANOS von Linstow, 1905cc.

Synonym.—Taenia laticollis Rudolphi of von Linstow, 1903*u*.

Specific diagnosis.—Taenia: Head with a rostellum armed with a single crown of 29 hooks. These hooks (fig. 42) are from 190 to 210 μ long and are shaped like rose-thorns, the handle shortened down to approximately the length of the guard or shorter. The strobila is 14.5 cm. long and attains its maximum width near its middle, where it is 2.86 mm. wide. The segments in the middle are wider than long; the terminal segments are longer than wide, 2.57 mm. long and 2.09 mm. wide. Mature segments are 0.99 to 1.18 mm. long and 2.25 mm. wide. The lateral margin of the strobila is serrate. The genital papillae are somewhat posterior of the middle of the lateral margin of the segment. The calcareous corpuscles are very numerous and partly pigmented black. The cuticular layer is thick and is separated from the medullary layer by a sheet of transverse muscles.

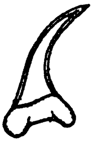

FIG. 42.—TAENIA MONOSTEPHANOS. HOOK. ENLARGED. AFTER VON LINSTOW, 1903.

Male genitalia.—The testes lie in the medullary layer of the segment wherever there are no female organs; they are 78 μ in diameter and are surrounded by a hyaline layer. The club-shaped cirrus pouch is 570 μ long, the cirrus is 290 μ wide and lies free in the genital sinus (?). The vas deferens is rolled in coils in the genital sinus (?).

Female genitalia.—The ovaries are fan-shaped and are composed of cells 13 μ in diameter and provided with large nuclei. The vitellarium is small, elongated along the transverse axis of the strobila and is composed of cells 7.8 μ in diameter and provided with brightly staining nuclei. The shell-gland is anterior of the vitellarium and is 160 μ in diameter. The vagina is 34 μ wide and terminates in a receptaculum seminis 110 μ long. The median stem of the uterus has numerous lateral branches which in turn send out secondary branches. The eggs are thick-shelled and are 29 to 36 μ in diameter.

Host.—Primary: *Lynx lynx* (*Felis lynx*). Secondary: Unknown.

Location.—In small intestine of primary host.

Locality.—Russia.

This species was first reported by von Linstow as *Taenia laticollis*, but as he later noted that Rudolphi's description and that of Leuckart called for the presence of the customary double crown of hooks, he described this form as a new species. If von Linstow's material is to be regarded as actually representative of the normal morphology of the species to which it belongs, then it should be given generic or subgeneric rank on the basis of the single crown of hooks, which is, if anything, more striking than the entire absence of hooks in *Taeniarhynchus saginatus*, *T. africanus*, etc., since the causes which might operate to abolish one row of hooks in the genus *Taenia* s. s. might reasonably be expected to abolish an intercalated row at the same time. It has not seemed advisable to create a new genus for this species for the reason that new data should be added in confirmation of the idea that the conditions reported were normal. It is not an uncommon thing to find specimens of tapeworm in which all the hooks are missing. It sometimes happens that a single row is missing, and the writer (Hall, 1910) reported the loss of the large hooks as a common feature of *Taenia balaniceps.* In both cases, whether one or both rows of hooks are missing, it appears to be usually the result of trauma. What the nature of this traumatic injury may be is uncertain, but even in mounting specimens hooks will occasionally be detached. Railliet (1893) has noted that Leidy has described a specimen of *Taenia pisiformis* provided with a single circlet of hooks (variety *α monostephana* Diesing), that Bremser has described one without hooks (variety β *astephana* Diesing), and states in comment that these facts are not important and that they deal with material carelessly collected, or very old, or deteriorated material. There are, therefore, grounds for suspecting that the presence of a single row of hooks may be deemed accidental. It may be urged that there is correlated with this an unusual hook shape, consisting of a considerable reduction of the handle. This condition differs only in degree from that in other tapeworms where the handle is short and stubby. Without regarding it as at all impossible that *T. monostephanos* may prove to have a single row of hooks as a normal structure, the possibility that this may not prove to be the case makes it advisable to leave the matter as it stands and wait for further data.

The reason for including this species in a paper on the tapeworms of North America is that we have probably more information about the tapeworms of the lynxes than of any other of our wild North American carnivores, and a note of parasites found in other continents serves to aid in securing a really adequate study of the parasites of our native species.

Genus MULTICEPS Goeze, 1782*a*.

Synonyms.—Taenia Linnaeus, 1758*a*, part; *Cerebrina* Acharius, 1782; *Hydatigena* Goeze, 1782*a*, of Batsch, 1786*a*; *Vesicaria* Schrank, 1788*a*; *Hydatula* Abildgaard, 1790*a*, part; *Hydatis* Virey, 1798*a*, part; *Polycephalus* Zeder, 1800*a*; *Coenurus* Rudolphi, 1808*a*; *Polycephops* Rafinesque, 1815*a*; *Multiplex* Liautard in Hall, 1911 (reviewer's error). (For additional synonyms, see Hall, 1910.)

Generic diagnosis.—Taeniinae: Strobilate stage similar to that of genus *Taenia.* Large hooks usually with a sinuous handle. The vagina usually shows a reflexed loop in the vicinity of the lateral excretory canals. Larval stage a coenurus, a bladderworm with a parent vesicle to which are attached numerous heads, internal or external daughter bladders being present or absent.

Type-species.—*Multiceps multiceps* (Leske, 1780*a*) Hall, 1910.

KEY TO SPECIES OF MULTICEPS.

1. Mature segments wider than long; the lateral margins of each segment at times scalloped as a result of a number of constrictions or furrows passing around the segment transversely; the posterior margin of each segment prolonged posteriorly to overlap the anterior margin of the succeeding segment like a cuff. Small hook with short, blunt curving handle. Genital papilla very narrowly conical and near posterior margin of segment. Larva a coenurus with daughter bladders, found in the connective tissue of rodents________________________________*Multiceps serialis*, p. 51.

Mature segments longer than broad; the lateral margins of each segment smooth and not scalloped; the posterior margin of each segment prolonged very little or not at all to form a projection over the following segment. Small hooks with long slender handle. Genital papilla posterior of middle of segment but not near posterior margin. Larva a coenurus without daughter bladders, found in ungulates, especially ruminants____________2.

2. Small hook with long curving handle terminating in a narrow distal extremity. Large hook with tapering handle with sinuous outline. Testes do not extend posterior of the ovaries to the vicinity of the vitellarium or between the vitellarium and the ovaries. Larva a coenurus in the central nervous system of ungulates, especially ruminants.
Multiceps multiceps, p. 40.

Small hook with long straight handle terminating in a blunt distal extremity. Large hook with the handle not tapering, and either straight and blunt or bent dorsally just at the tip. Testes extend posterior of ovaries almost to the vitellarium and between the vitellarium and the ovaries. Larva a coenurus in the central nervous system, lungs, parenchymatous organs and connective tissue of ruminants________*Multiceps gaigeri*, p. 45.

MULTICEPS MULTICEPS (Leske, 1780*a*) Hall, 1910.

Synonyms.—*Taenia multiceps* Leske, 1780*a*; *Vermis vesicularis socialis* Bloch, 1780*a*; *Taenia vesicularis cerebrina* Goeze, 1782*a*; *Hydatigena cerebralis* Batsch, 1786*a*; *Vesicaria socialis* (Bloch, 1780*a*) Schrank, 1788*a*; *Taenia cerebralis* (Batsch, 1786*a*) Gmelin, 1790*a*; *Polycephalus ovinus* Zeder, 1803*a*; *Coenurus cerebralis*

(Batsch, 1786*a*) Rudolphi, 1808*a; Polycephalus coenurus* Tschudi, 1837*a; Taenia multiplex* Leuckart, 1852*b; Taenia coenurus* (Tschudi, 1837*a*) Küchenmeister, 1853*e;*. *Multiplex multiplex* (Leuckart, 1852*b*) Liautard in Hall, 1911 (reviewer's error). (For additional synonyms, see Hall, 1910.)

Specific diagnosis.—Multiceps: The head is piriform in lateral view and presents a square outline when viewed en face, and is about 800 μ in diameter. The weakly developed rostellum is about 300 μ in diameter and bears a double crown of 22 to 32 hooks. The large hooks (fig. 43) are 150 to 170 μ long. The blade has only a slight curvature; the handle is straight in its general direction, its dorsal and ventral borders sinuous and subparallel, commonly notched on the dorsal border at a point between the middle of the handle and the union with the blade, tapering more or less toward the distal extremity and tending to turn dorsally at this extremity; the guard is subcylindrical proximally and more or less conical distally, usually with a slight thickening at the union of the proximal and distal portions. The small hooks are 90 to 130 μ long. They have a blade of moderate to strong curvature; the handle is relatively long and tapering, usually curved, with the convexity on the dorsal side, along most of its length and with the distal extremity turning dorsally; the guard, in lateral view, is usually subcylindrical in the proximal portion and irregularly rounded conical distally, the thickest point being at the union of the proximal and distal portion, and is slightly grooved in the median line in a way which gives the hook in some views the appearance of being bifid. The suckers are located at the corners of the head and have a diameter of 290 to 300 μ. There is a distinct neck which may be 2 to 3 mm. long from the posterior margin of the suckers to the first distinct segmentation. The strobila (fig. 44) attains a length of 40 to 100 cm., and consists of 200 to 250 thin and relatively translucent segments, with a maximum width of about 5 mm. The genital primordia appear rather late and the first things to stain clearly in toto mounts are the genital pore and the genital canals from the genital pore inward. The pores are distinct about 4.7 cm. back of the head, in about the eighteenth segment. The segments are mature about 10 to 18 cm. back of the head, the first mature segment being about the one hundred and twenty-fifth. The mature segments (fig. 45) are either square or oblong and longer than wide, but not wider than long. Mature segments have gently

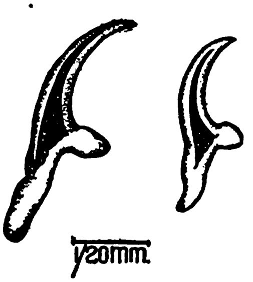

FIG. 43.—MULTICEPS MULTICEPS. LARGE AND SMALL HOOKS.

convex lateral margins. There are from 12 to 20 gravid segments, from 6 to 11 mm. long and 3 to 5 mm. wide, usually not over 4 mm. The calcareous corpuscles are very small, 15 to 16 μ in diameter. The longitudinal excretory canals are small, the ventral lying about 420 μ from the margin of the segment. The genital papilla is rather flat, but is quite distinct as a result of the translucency of this worm.

Male genitalia.—There are about 200 testes in one horizontal plane. They are principally confined to the lateral portions of the median field near the longitudinal canals, a few scattering testes occupying a more median position anteriorly, but leaving a fairly wide and distinct field about the median stem of the uterus (fig. 45). The testes do not press close to the field of the vas deferens and vagina, and leave a fairly wide free field on each side of these canals. They extend alongside of the ovaries but do not press close to them and do not pass posterior of the ovaries in the direction of the vitellarium. The testes are practically confined to the fields lying lateral of lines drawn parallel to the longitudinal axis of the strobila through the lateral edges of the ovaries. The vas deferens originates close to the median stem of the uterus on the pore side of the segment and extends in a series of loops to the cirrus pouch. The cirrus pouch usually originates in the field lateral of the longitudinal excretory canals and is either curved, with the convexity of the curve toward the anterior portion of the segment, in which case the vagina follows the curve on the concave posterior side, or is straight and more or less piriform or cylindrical, in which case the vagina comes in from the genital eminence to about the middle of the cirrus pouch and then bends off at a right angle or even turns back toward the lateral margin for a short distance. The cirrus pouch is 315 to 350 μ long and is 110 to 145 μ wide.

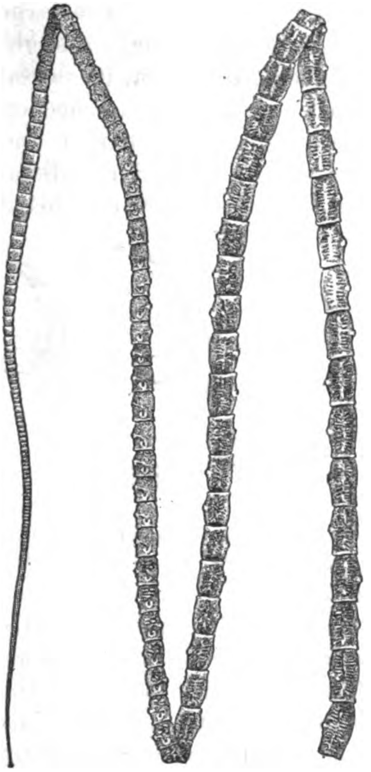
FIG. 44.—MULTICEPS MULTICEPS. ENTIRE STROBILA. ACTUAL SIZE. AFTER HALL, 1910.

Female genitalia.—The ovaries are somewhat elongated along the longitudinal axis of the strobila and inclose an interovarian field that is truncate conical to somewhat conical in shape (fig. 45). They are very nearly equal in size. The vitellarium is small, triangular, and of reticular structure and rather widely set off from the other male or female genital glands. The median point may or may not project slightly between the ovaries but the vitellarium does not extend laterally as far as the ovaries. The shell-gland is small, distinct, and lies in the clear. The vagina follows the conformation of the vas deferens, as noted above in the discussion of the male genitalia, and then curves in around the nearest ovary to the receptaculum seminis in the interovarian field. In the transition from mature to gravid segments, a striking feature is the almost constant formation of two lateral branches, one on each side, between the ovary and the vitellarium. In gravid segments (fig. 46), the median stem of the uterus has from 9 to 26 lateral branches, rather distinctly parallel to one another for the most part, and most of these in turn giving rise to a very few secondary branches, which usually remain quite distinct and without tendency to fuse. The eggs are from 29 to 37 μ in diameter and have a shell 4 μ thick.

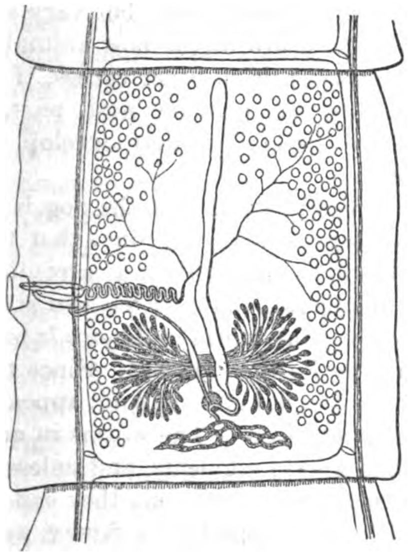

FIG. 45.—MULTICEPS MULTICEPS. MATURE SEGMENT. ENLARGED. AFTER DEFFKE, 1891.

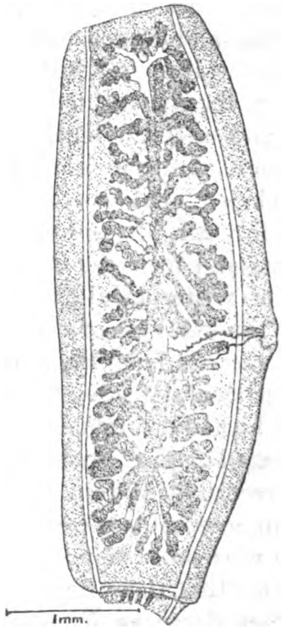

FIG. 46.—MULTICEPS MULTICEPS. GRAVID SEGMENT. AFTER HALL, 1910.

Hosts.—Primary: *Canis familiaris*, *C. nebracensis*. Secondary: *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, chamois, mouflon, gazelle, antelope, African antelope, *Bubalis* sp., *Ozanna equina* (*Hippotragus equinus*), *Homo sapiens*.

Location.—In small intestine of primary host. In central nervous system, brain or spinal cord, of secondary host.

Localities.—Greece, Germany, Switzerland, England, France, Italy, Ireland, Holland, Scotland, Austria, Denmark, Iceland, Argentine Republic, Sardinia, South Australia, New Zealand, German Southwest Africa, India, Hungary, Cape Colony, Chile, Spain, Shetland, Algeria, United States.

Life history.—Eggs developed by the adult worm in the intestine of the primary host pass out and are ingested in contaminated food or water by the secondary host. In the digestive tract an embryo is released and bores its way through the tissues and into the blood stream. An embryo which attains the central nervous system will develop and form a coenurus which, unless removed by surgical interference, ultimately kills the host animal. The embryos which do not attain the central nervous system begin development, but very soon die and undergo degeneration. On the death of the host animal, as a result of the pressure of the parasite or from other causes, if the developed bladderworm is ingested by the primary host, part, or possibly all, of the heads attached to the bladder may develop segments and form the strobilate worm.

The writer (Hall, 1910) has previously stated that the dog is the only known host of the adult *Multiceps multiceps.* Since that time two records from the coyote (Hall, 1911; Hall, 1912), as a result of experimental feedings, have been published. The writer also stated that he had not found the record of the adult worm in *Alopex lagopus* (*Canis lagopus*) credited to Möbius by Railliet (1893a). Since then the record by Möbius (1874) has been found, but it does not appear to be an acceptable record of *Multiceps multiceps.* The worms in question were 55 to 65 mm. long and had gravid segments, and unless we assume that these figures are an error for 55 to 65 cm., they can not be considered as *M. multiceps.* In other respects the figures agree fairly well with *M. multiceps*—95 to 113 segments; head 800 µ wide; a double crown of 26 hooks, the large 160 µ long and the small 120 µ long; the segments quadratic two-thirds of the distance from the head and 2 mm. long and wide; the terminal segments 3 mm. long and 2.6 mm. wide; uterus with 12 to 16 lateral branches; maximum egg measurements 31.5 by 27.4 µ. He states that the shape of the hooks agrees with those of *M. multiceps.* The size of the terminal segments is not quite that of *M. multiceps*, but as there appears to be some possibility of error in the figures given for the strobila, there may also be some in those for the segments. The writer further stated, in the paper noted above, that there were no satisfactory records of larval *M. multiceps* from man. Brumpt (1913) has since recorded a case in which he gives data and figures that must be accepted as a case of this parasite from the brain of man.

MULTICEPS GAIGERI Hall, 1916.

Synonym.—Coenurus serialis Gervais, 1847*a*, of Gaiger, 1907, and Dey, 1909.

Specific diagnosis.—Multiceps: The head is somewhat piriform in lateral view and almost square when viewed en face, and is about 950 μ in diameter. The weak rostellum is about 360 μ in diameter and bears a double crown of 28 to 32 hooks. The large hooks (fig. 47) are 160 to 180 μ long. The blade is of slight curvature; the handle is nearly straight or only slightly sinuous, with usually a notch, slight or very pronounced, on the dorsal border between the middle of the handle and the union with the blade, the dorsal and ventral borders approximately parallel and the handle not tapering but ending bluntly and at times with a slight curvature dorsally at the distal extremity; the guard is approximately cordiform in lateral view, the point of maximum thickness being a short distance from the union with the blade and handle, thus forming a neck proximally and a roundly conical distal portion. The small hooks are 115 to 150 μ long. The blade is strongly curved; the handle is long, straight, slightly sinuous in outline, and tapering to a rather blunt tip; the guard is rather oval in lateral view, has a slight median ventral depression without being bifid, and meets the handle at a very obtuse angle, almost a straight angle. The suckers are comparatively large, set prominently at the angles of the quadrate head and with relatively small intervals between adjacent suckers, and have a bulb diameter of 310 to 330 μ. The neck is quite distinct, of smaller diameter than the head, and may measure around 690 μ in length. The entire strobila may measure from 25 cm. to 1.82 meters, according to conditions and individual development. In a well-developed strobila, about 40 cm. long, the segments become square about the middle of the strobila, being 5 mm. long and 5 mm. wide at a distance of 20 cm. from the head. As the segments become longer than wide they become mature. At 30 cm. from the head they are 7 mm. long and 5 mm. wide. At 40 cm. from the head the segments are 14 mm. long and 2 to 3 mm. wide. The entire strobila is rather

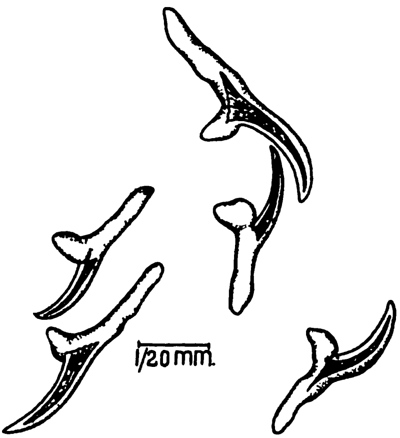

FIG. 47.—MULTICEPS GAIGERI. LARGE AND SMALL HOOKS. FROM HALL, 1916a.

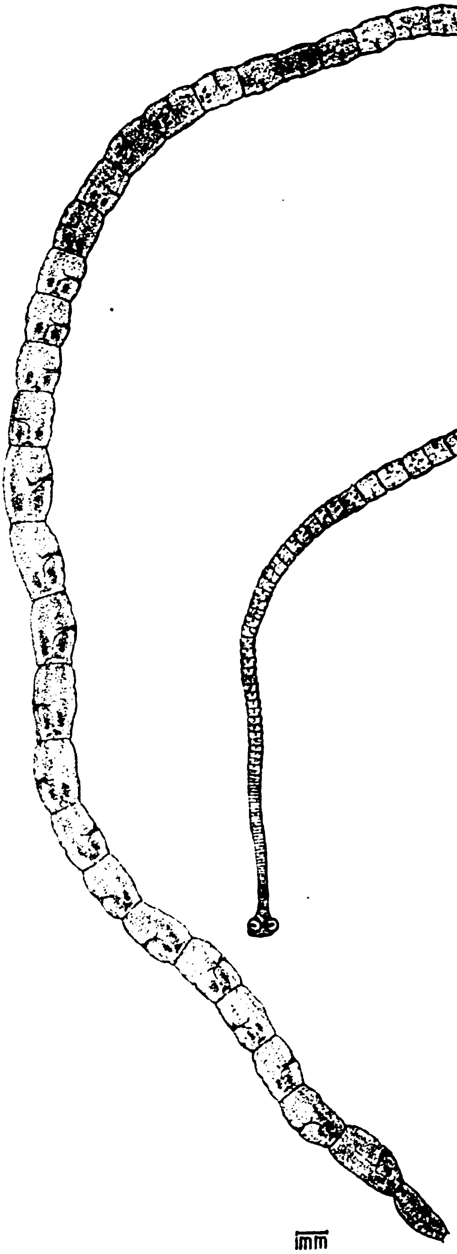

FIG. 48.—MULTICEPS GAIGERI. YOUNG STROBILA. FROM HALL, 1916a.

thin, delicate, and comparatively translucent (fig. 48). The genital primordia appear in about the thirtieth segment, between 2 and 3 mm. back of the head, first as deeper staining areas in the median line. These areas become angular, the legs of the angles forming the genital canals. The primordium of the median stem of the uterus is the next thing visible. Calcareous corpuscles are especially large and abundant in the medullary portion of the head and the anterior portion of the neck, where they are elliptical and about 13 by 8 µ in diameter, but are elsewhere small, oval, about 4 or 5 µ in length, and, though numerous, are relatively inconspicuous. The longitudinal excretory canals are quite distinct, the ventral canal situated about 225 µ from the margin of the segment and the dorsal canal lying lateral of this. The genital papilla is flat and inconspicuous, an actual papilla formation being lacking as a rule, but is readily observed, owing to the translucency of the segments.

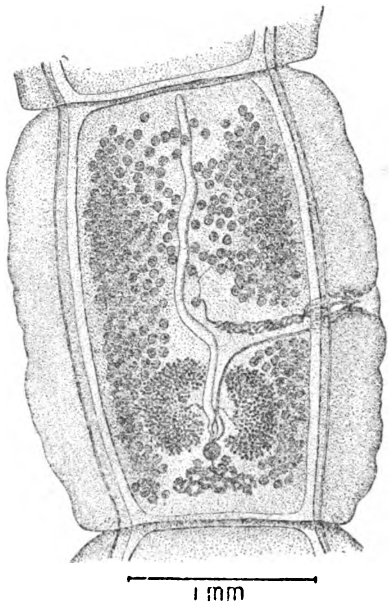

FIG. 49.—MULTICEPS GAIGERI. MATURE SEGMENT. FROM HALL, 1916a.

Male genitalia.—There are between 200 and 225 large, irregularly spherical testes, confined principally to the lateral portions of the median field in the vicinity of the longitudinal excretory canals (fig. 49). There is a wide field about the median stem of the uterus which is free or comparatively free from testes, only an occasional two or three occurring here. The field about the vas deferens and vagina is also comparatively free from testes for some distance on each side. The testes press close to and even in contact with the lateral borders of the ovaries and also extend to the vitellarium and between the vitellarium and the ovaries. The vas deferens begins close to the median stem of the uterus on the pore side and first extends at an angle posteriorly and laterally. It is very much looped from its origin, the loops extending widely along the longitudinal axis of the worm, even across the vagina, and also back and forth along the general path of the vas deferens, the loops being so numerous as to form a dense wide structure. The cirrus pouch extends to the median border of the ventral excretory canal. It is piriform to elongate elliptical in shape, often with a concavity on the posterior side, toward the vagina, and about 260 µ long by 100 to 125 µ wide.

Female genitalia.—The ovaries (fig. 49) are elongated along the longitudinal axis of the strobila, of the same size, and reniform to fan-shaped, the interovarian field varying correspondingly from oval to almost quadrilateral. The vitellarium is roughly triangular in outline, the anterior angle projecting a short distance into the interovarian field and occasionally suppressed at this point to form a truncated or even invaginated structure for the reception of the shell-gland. The vitellarium is often irregular or asymmetrical and in some segments may even be elongated along the longitudinal axis of the strobila, a quite distinctive feature (fig. 50). The vitellarium does not extend laterally as far as the ovaries do. The shell-gland is comparatively large, at times distinctly in the clear near the anterior apex of the vitellarium and at times apparently in contact with the vitellarium or occupying an invagination at the anterior apex of the vitellarium. The vagina follows the general contour of the portion of the cirrus pouch lying nearest the lateral margin of the segment, being straight when the cirrus pouch is straight and following the concavity when the pouch is concave posteriorly. It then bends abruptly, usually at right angles, but at times at an obtuse angle or again at an acute angle back toward the margin of the segment. It then turns medially and after pursuing a short wavy course, with usually two crests, or even making another loop, it swings in a wide curve around the nearest ovary to the receptaculum seminis in the interovarian field. In gravid segments the median stem of the uterus is very wide and has from 12 to 15 wide lateral branches which in turn send out wide secondary branches. The median field of the narrow segments is thus reduced to nearly a solid mass of eggs, the space between the wide uterine areas being very small. The eggs are nearly spherical and are 25 to 30 μ in diameter.

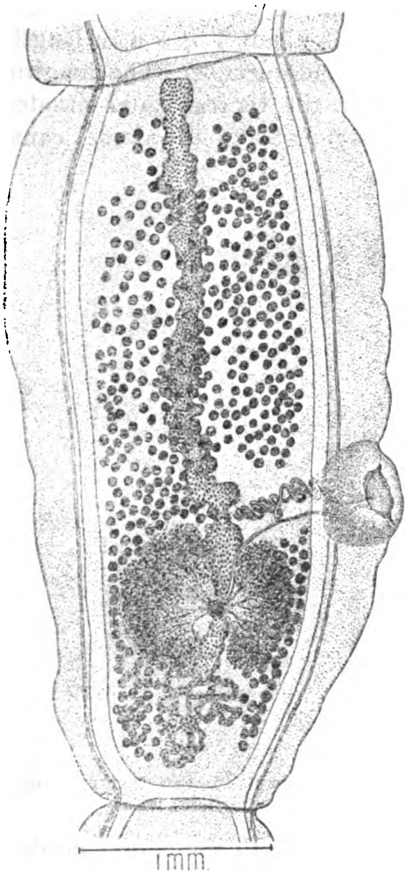

FIG. 50.—MULTICEPS GAIGERI. MATURE SEGMENT SHOWING THE OCCASIONAL ELONGATION OF THE VITELLARIUM ALONG THE LONGITUDINAL AXIS OF THE STROBILA. FROM HALL, 1916a.

Hosts.—Primary: *Canis familiaris.* Secondary: *Capra hircus.*

Location.—In small intestine of primary host. In central nervous system, liver, lungs, spleen, kidney, bladder, intermuscular connective tissue, under peritoneum and subcutaneous in secondary host.

Locality.—India (Punjab, at Lahore, and Bengal) and Ceylon.

Type-material.—U. S. National Museum No. 16590. (Bureau of Animal Industry Helminthological Collection.)

Life history.—Eggs produced by the adult worm in the primary host pass out and are ingested by the secondary host in contaminated food and water. In the digestive tract the embryo escapes from its shell and migrates into the tissues of the host, where it develops into a coenuriform larva. On ingestion of this larva by the primary host, some or all of the heads attached to it may give rise to strobilate worms in the intestine.

Gaiger (1907) first recorded this parasite from the goat at Lahore, India. He had two cases of the larval parasite occuring in the connective tissue, and because of the site of the worm and the presence of what he regarded as daughter cysts, he concluded that the parasite was *Multiceps serialis*, the form commonly found in the connective tissues of the rabbit, rather than *M. multiceps*, the form commonly found in the central nervous system of ungulates. He fed some cyst material to a dog and to a rat. The rat died in two days and the hooks were recovered from the stomach. The dog began passing segments of tapeworm on the fourteenth day and was killed on the thirty-first day. The small intestines were found packed with tapeworms from 1 to 40 cm. long.

Two years later, Dey (1909) reported this parasite from the goat in Bengal, India. In this case the parasites were found in the brain, intermuscular connective tissue, in subcutaneous situations, and in the mesenteries and attached to the peritoneum of the abdominal wall and the serous covering on the viscera. A dog was first treated with taeniacides and purgatives and then fed some cyst material. In a month and a half the dog began passing segments of tapeworm and and was killed two weeks later. Seventy-five tapeworms, the longest 1.82 meters long, were recovered from the small intestine, and the scolices found to agree with those of the coenurus.

Southwell (1912) reports *Coenurus serialis* from the goat and *Taenia serialis* from the dog in Ceylon. The record from the goat must be regarded as a record of *M. gaigeri*, and that from the dog may be.

Gaiger (1915) lists it from the goat in India with a note to the effect that it is common.

In a previous paper (Hall, 1910*b*), Gaiger's and Dey's records of *M. serialis* from the goat were provisionally accepted as correct, with a note to the effect that the parasite would receive further attention later. Through the courtesy of Doctor Gaiger, specimens of the coenurus from the goat and of the tapeworm from the dog were furnished to the United States Bureau of Animal Industry, and an examination of these showed them to be a new species. That there are no rabbits in India, a fact Gaiger (1909, 530) has himself noted, would suggest something of the sort. The specimens of the adult worm are much smaller than the largest specimens noted by Dey, but as the size depends largely on whether fresh material is measured in a stretched condition or preserved material is measured on a flat surface this is a small matter. In the specimen which I have designated as type, the segments are mature about 5.5 to 6.5 cm. back of the head. The general anatomy of the species is much more nearly that of *M. multiceps* than *M. serialis*. The strobila is delicate and the vagina shows a peculiar bend which is strongly suggestive of the condition in *M. multiceps*. The hooks are also suggestive of *M. multiceps*. Gaiger states that the small hook has a bifid guard, but this statement is often made of tapeworms that do not have a bifid guard. In these cases, as in this species, there is an appearance of bifidity found on focusing which is due to the fact that the lateral margins of the guard are commonly thickened and the median ventral portion thinned and often slightly grooved, but such conditions must be differentiated from the condition of true bifidity which is found in such hooks as those of *Taenia pisiformis*.

An examination of the larva shows it to be more closely related to *M. multiceps* than to *M. serialis* morphologically. Placed in a dish with typical specimens of these species it resembles the former much more than the latter, and the same is true of scolices detached from all three species. Gaiger (1907) states "there was a very distinct tendency in most cysts towards budding off of daughter cysts, and although actual separation of a daughter cyst was not seen, in one case there was a distinct neck dividing off a portion of the parent cyst. Internal budding was complete and many of the cysts were floating free. The daughter cysts were never more than 2 mm. broad and 4 long, and were always egg-shaped with one head at the narrow end. The majority of them were attached by a minute pedicle to the parent cyst, but could be easily detached, and often they were present in bunches, both attached and free." I find on examination that a striking feature of this species, so far as the available material is concerned, is the extraordinary ease with which the heads detach from the bladder wall and so come to lie free in the internal fluid. The great majority of the heads in the available specimen are free and lie in a mass inside the bladder, their former position being marked by neat prominent apertures perforating the bladder wall. This is the obvious explanation of Gaiger's statement regarding daughter bladders. These are deciduous scolices, but they are not daughter bladders. It is interesting to note that we have here a condition suggestive of what must have been the origin of daughter bladders, namely, a deciduous scolex, but it is so recent a development here that the cyst has not yet developed a reparative process at the site where the scolex separates. This species is apparently intermediate between *M. multiceps* and *M. serialis* in this and other respects. It presents an interesting study from a physiological standpoint in that it is capable of development in the central nervous system and also in the connective tissues and on serous surfaces, thus combining the sites of the other species, and causes the formation of an adventitious capsule, as *M. serialis* does and *M. multiceps* does not, even adhering tightly to the brain, from which *M. multiceps* slips very easily and with no trace of adhesions.

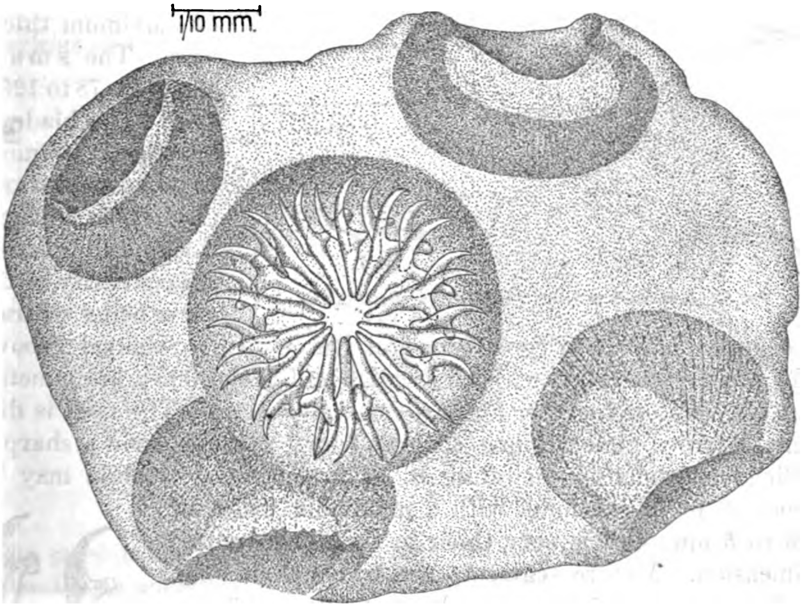

FIG. 51.—MULTICEPS SERIALIS. HEAD VIEWED FROM THE FRONT.

MULTICEPS SERIALIS (Gervais, 1847*a*) Stiles and Stevenson, 1905*a*.

Synonyms.—Coenurus serialis Gervais, 1847*a*; *Taenia serialis* (Gervais, 1847*a*) Baillet, 1863*a*; *Coenurus cuniculi* (Diesing, 1863*b*) Cobbold, 1864*b*; *Coenurus lowzowi* Lindemann, 1867*a*; *Multiplex serialis* (Gervais, 1847*a*) Liautard in Hall, 1911 (reviewer's error). (For additional synonymy, see Hall, 1910.)

Specific diagnosis.—Multiceps: The head (fig. 51) is approximately spherical when viewed from the side, but quadrangular when viewed en face, and is 850 µ to 1.5 mm. in diameter. The rostellum is about 390 μ in diameter and bears a double crown of 26 to 32 hooks. The large hooks (figs. 52 and 53) are 135 to 175 μ long. The blade is of moderate curvature; the handle is slightly sinuous in outline, frequently tapering slightly and with a tendency to turn dorsally at the distal extremity; the guard is somewhat cordiform in lateral view, the maximum diameter being a short distance from the union with the blade and handle, and with a projection toward the blade along this line of maximum thickness. The small hooks are 78 to 120 μ long. The blade is of strong to moderate curvature; the handle is short, thick, and curved, the convexity of the curve being ventral; the guard is oval to cordiform and has a median ventral groove. The suckers are large, with a muscular bulb about 300 μ in diameter, but are set close together and are not conspicuous. The neck is distinct, narrow, almost 1 mm. long and may at times have a sharply defined constriction encircling it. The developed strobila may be from 20 to 72 cm. long, with a maximum width of 3.5 to 5 mm. and is very thick in the dorso-ventral dimension. Mature segments are wider than long, and are between 1.5 and 2 mm. long, and 2.5 and 3 mm. wide. Gravid segments are longer than wide and may be 6 to 12 mm. long and 3 to 4 mm. wide. The outline of the strobila is neither serrate nor smooth, but is uneven as a result of transverse furrows of the segments, the normal convexity of the segments and the prominence of the genital papillae. Calcareous corpuscles are extremely abundant, oval in shape, with a maximum diameter of about 20 μ, and are a prominent factor in making the strobila very dense and opaque. In young segments the posterior angles of each segment are considerably prolonged, but the prolongation extends posteriorly rather than lat-

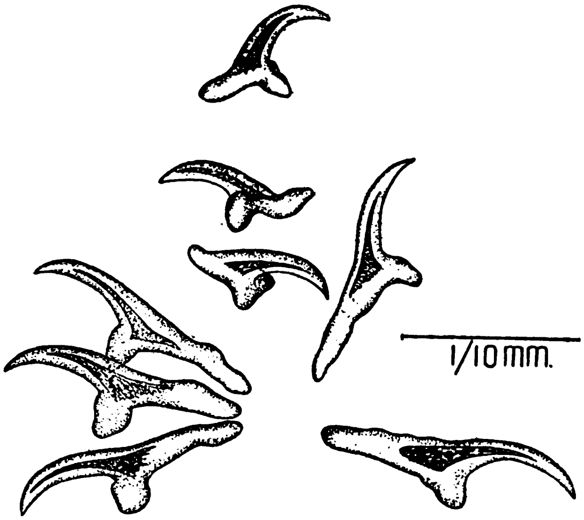

Fig. 52.—Multiceps serialis. Large and small hooks.

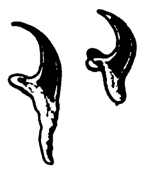

Fig. 53.—Multiceps serialis. Large and small hooks. Enlarged. After Neumann 1892.

erally, and so lies close to the succeeding segment instead of projecting and forming a prominent angle and thus giving a serrate appearance to the strobila. In older segments, the posterior segment margin is prolonged to form an infundibuliform portion which surrounds the anterior portion of the succeeding segment (fig. 54). In a naked eye inspection of the strobila this prolongation is seen as a pale, fairly wide band separating the segments, whereas most related tapeworms show a narrow depression between adjacent segments. The genital papilla is very prominent and is situated posterior of the middle of the segment, sometimes slightly posterior and often very much posterior, even practically at the posterior edge of the lateral border; it is very rarely in the middle of the segment. The genital cone is frequently set very deep at the bottom of the genital pore. The genital primordia appear almost immediately behind the neck as densely staining areas in the median line. Farther back on the strobila the genital canals and the median stem of the uterus develop as outgrowths from this central area.

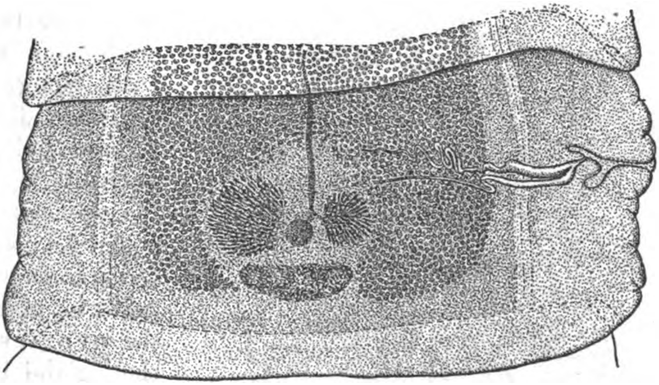

FIG. 54.—MULTICEPS SERIALIS. MATURE SEGMENT. ENLARGED.

Male genitalia.—The testes (fig. 54) are numerous and set close together throughout the testicular field. In the segments in which they first appear they do not occur in the field of the median stem of the uterus, but subsequently this field is invaded, as is also the field of the vas deferens and vagina. They extend in intimate contact with the lateral margins of the ovaries to the vitellarium and posterior of the ovaries. Anterior of the ovaries there is an approximately square field free from testes, the lateral testicular fields being connected by a rather straight band of testes crossing the anterior portion of the segment. The vas deferens apparently originates at some distance from the median stem of the uterus on the pore side of the segment and is apparently very little looped. The cirrus pouch is a very narrow, elongated, nozzle-shaped structure, the distance from the median end of the cirrus pouch to the tip of the very narrowly elongate conical genital eminence being 200 to 300 µ and the maximum width, near the median end, 55 to 99 µ; the pouch is occasionally bent or curved; it is expanded to contain the few loops of the cirrus only in the median portion. The external aperture is often on the side, rather than the tip, of the genital cone.

Female genitalia.—The ovaries are often of approximately equal size and elongated along the transverse axis of the strobila. The vitellarium is likewise elongated in the same direction; it does not extend laterally as far as the ovaries; in toto mounts it sometimes seems to connect the posterior portions of the ovaries. The shell gland is small and inconspicuous. The vagina comes in from the lateral margin of the segment, presents a reflexed loop, or several loops, near the longitudinal excretory canal and curves sharply around the nearest ovary to the interovarian field. In gravid segments (fig. 55) the median stem of the uterus has 20 to 25 lateral branches, or so many branches which in turn send out numerous anastomosing branches that a count is impossible. The entire median field is filled with uterine developments to the point where almost no remaining parenchyma can be detected between the growths. Even in gravid segments the posterior flap of the segments overlaps the anterior portion of the succeeding segment so much as to

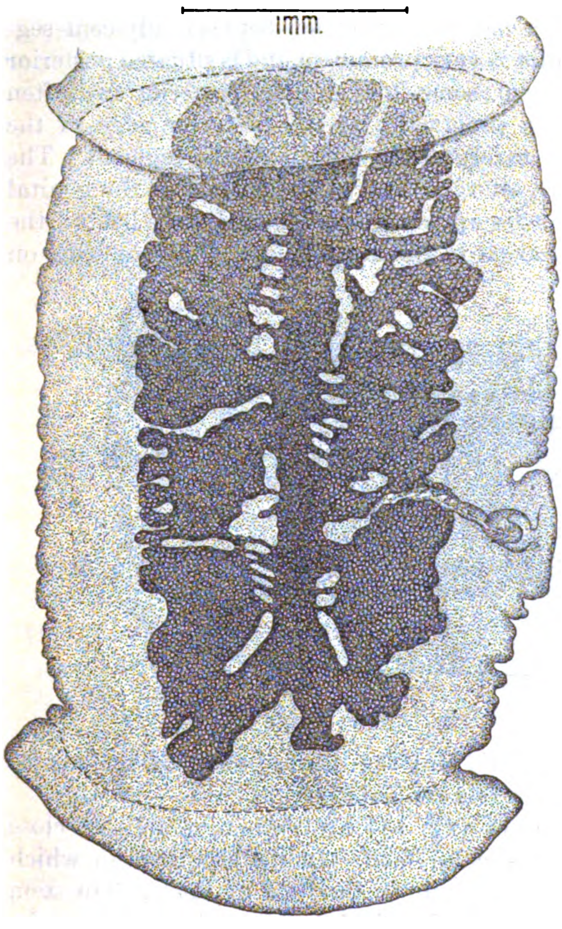

FIG. 55.—MULTICEPS SERIALIS. GRAVID SEGMENT.

distinctly overlap the anterior end of the uterus, whereas in related tapeworms gravid segments show a tendency to become very distinctly separated and constricted at their point of contact with other segments. The eggs are elliptical, 31 to 34 µ by 29 to 30 µ in diameter.

Hosts.—Primary: *Canis familiaris.* Secondary: *Lepus europaeus* (*L. timidus*), *L. californicus*, *L. c. wallawalla*, *L. c. deserticola*, *L. timidus* (*L. variabilis*), *L. californicus texianus* (*L. texianus*), *L. callotis*, *Oryctolagus cuniculus*, *L. cuniculus domesticus* (*L. cuniculus*), *Sciurus vulpinus* (?), *S. niger neglectus* (*S. vulgaris*), *S. carolinensis* (?), *Myocastor coypus* (*Myopotamus coypus*).

Location.—In the small intestine of the primary host. In the connective tissue of the secondary hosts, intermuscular, subcutaneous, etc.

Localities.—England, Scotland, France, Switzerland, Italy, Russia, Siberia, Australia, New Zealand, Japan, India, Tunis, and the United States.

Life history.—Eggs developed by the adult worm in the intestine of the primary host pass out and are ingested by the secondary host with contaminated food and water. In the digestive tract of the secondary host the embryo escapes and bores into the tissues and possibly into the circulation of the host. In the connective tissue under the skin, between the muscles, and elsewhere, it comes to rest and develops into a larval form, or coenurus, with numerous heads attached and also with the production of internal and external daughter bladders which in turn develop numerous heads. On ingestion of these bladders by the primary host the tapeworm heads develop segments and form the strobilate worm.

The thickness of this worm and the number of calcareous corpuscles make it an unfavorable subject for toto mounts. Unless the calcareous corpuscles are eliminated by the use of some acid, the resulting mounts will be very unsatisfactory, and even after they are eliminated the thickness of the worm makes it a very much less satisfactory mount than such translucent worms as *M. multiceps*, *M. gaigeri*, or even such worms as *Taenia pisiformis.* The description given above is based on specimens furnished to the United States Bureau of Animal Industry through the courtesy of Professor Railliet. Material from North America available to the present writer through the courtesy of Prof. F. D. Barker, of the University of Nebraska, appears to conform in essential respects to the European form.

In a previous paper (Hall, 1910) I have noted that the records of this parasite from the squirrel were probably correct. Since then I have recorded (Hall, 1911) the development of this species in *Sciurus carolinensis.*

In the same paper (Hall, 1910) I stated that the parasite apparently did not occur in Germany. Later information is to the same effect. It would be interesting to know why a parasite which occurs in France, Switzerland, Italy, Russia, and Siberia does not, apparently, occur in Germany, Austria, and Hungary, in spite of the fact that primary and secondary hosts are present in the countries in question, and so far as any one knows, under circumstances presumably as favorable as in the countries in which the parasite is found.

Genus ECHINOCOCCUS Rudolphi, 1801*a*.

Synonyms.—*Acephalocystis* Laennec, 1804; *Liococcus* Bremser, 1819*a*; *Splanchnococcus* Bremser, 1819*a*; *Echinokokkus* Buhl, 1856*a*; *Echinococcifer* Weinland, 1858*a*. (For additional synonyms see Stiles and Stevenson, 1905*a*.)

Generic diagnosis.—Taeniinae: Strobila composed of not over four or five segments, of which only the posterior terminal segment is gravid. Head armed with a double crown of hooks. Genital pores marginal and irregularly alternate. Larval stage an echinococcus, a bladderworm with a thick laminated wall and with or without internal or external daughter cysts; brood capsules develop in the mother or daughter cysts and contain several scolices. Adults in carnivorous animals; larval stage in herbivorous and omnivorous animals.

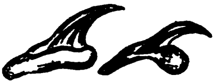

FIG. 56.—ECHINOCOCCUS GRANULOSUS. LARGE AND SMALL HOOKS. × 300. AFTER LEUCKART, 1880.

Type-species.—*Echinococcus granulosus* (Batsch, 1786*a*) Rudolphi, 1805*a*.

ECHINOCOCCUS GRANULOSUS (Batsch, 1786*a*) Rudolphi, 1805*a*.

Synonyms.—*Taenia echinococcus* Siebold, 1853; *Echinococcifer echinococcus* (von Siebold, 1853) Weinland, 1861; *Taenia echinococca* Koeberle, 1861*a*; *Taenia* (*Echinococcifer*) *echinococcus* of Leuckart, 1863; *Taenia* (*Arhynchotaenia*) *echinococcus* of Diesing, 1864*a*; *Taenia echinoccus* von Linstow, 1878; *Taenia* (*Echinococcus*) *echinococcus* of Railliet, 1885*a*. (For additional synonyms, see Stiles, 1906*a*.)

Specific diagnosis.—*Echinococcus*: Head very small, subglobular, scarcely 300 μ in diameter. Rostellum prominent, armed with a double crown of 28 to 50 hooklets. The large hooks (fig. 56) are 22 to 30 μ long (40 to 45 μ, according to Leuckart). They have a blade of very slight curvature, which tends to lie in a prolongation of the longitudinal axis of the handle, and which is very thick at the base; the handle is rather straight, short, and thick, and with dorsal and ventral swellings in the median portion; the guard is excessively shortened and rounded, forming practically a hemispherical protuberance. The small hooks (fig. 56) are 18 to 22 μ long (30 to 38 μ, according to Leuckart). The blade is very short and very little curved, and tends to lie in a prolongation of the longitudinal axis of the handle; the handle is comparatively long and narrow, with a prominent dorsal swelling near the middle which causes a tapering to the distal extremity; the guard is relatively very much enlarged and oval in outline. The suckers are 130 μ in diameter and are set well back from the rostellum. The neck attenuates posterior of the suckers and then gradually increases in width to meet the anterior margin of the first segment (fig. 57). This first segment is almost square, about 240 to 260 μ long and wide, and is sterile. The second segment is about twice as broad in its posterior portion as the first segment and is about four times as long, and is mature. The third segment is gravid and is much larger than the second, attaining a maximum length of about 2 mm. and a width of 600 μ. The longitudinal excretory canals are visible and calcareous corpuscles are present.

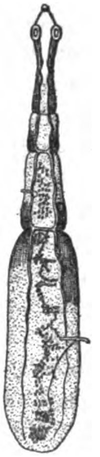

Fig. 57.—Echinococcus granulosus. Strobilate tapeworm. Enlarged. After Leuckart, 1880.

Male genitalia.—Testes 70 μ in diameter and about 40 to 60 to the segment, most of them in the anterior and posterior ends and on the aporal side of the median field. The vas deferens originates near the median line of the segment, anterior of the ovary and on the pore side of the median stem of the uterus, and has a few wide coils before entering the cirrus pouch (fig. 58). In its general course it extends diagonally forward to the cirrus pouch, which is about 500 μ long and extends almost to the median line of the segment.

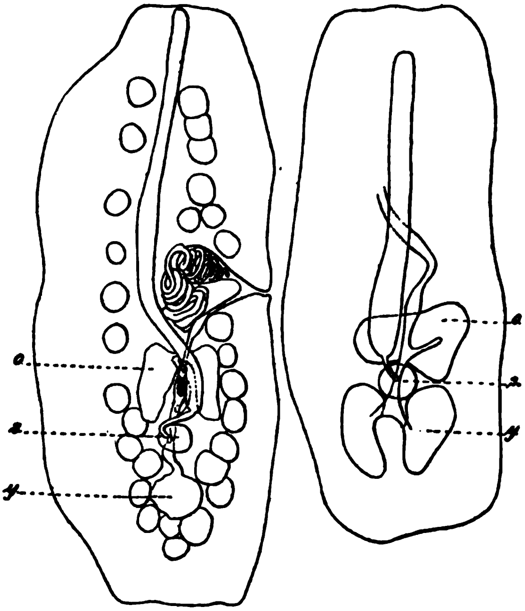

Fig. 58.—Echinococcus granulosus. Frontal sections of mature segments. o, Ovary; s, shell-gland; y, yolk-gland. Enlarged. After von Erlanger, 1890.

Female genitalia.—The ovary is horseshoe-shaped (fig. 58), with the median isthmus narrower than the ends, and the concavity posterior is submedian in position and about halfway between the plane of the genital pore and the posterior border of the segment. The vitellarium is situated near the posterior border of the segment; it consists of two lobes, a dorsal and a ventral, lying one above the other, the lobes in turn being formed of two portions, each with its own duct. The shell-gland is spherical to oval. The ovaries, vitellarium, and uterus have the common openings of their tubes within the shell-gland. The vagina has a large, elongate, setose dilation about 50 μ in diameter near the genital pore and bends at an obtuse angle median of this to extend posteriorly and medially to a receptaculum seminis about 14 μ in diameter. The uterus develops comparatively late, forming a median stem and lateral enlargements, the outlines of these later becoming quite indistinct. The eggs are 32 to 36 μ by 25 to 30 μ in diameter.

Hosts.—Primary: *Canis familiaris*, *C. lupus*, *C. aureus*, *C. dingo*, *C. mesomelas*, *Felis catus* (*F. c. domestica*), *F. concolor*. Secondary: *Homo sapiens*, *Bos taurus*, *Ovis aries*, *Capra hircus*, *Sus scrofa domestica*, *S. scrofa*, *Pithecus* species (*Simia cynomolgus*), *Pithecus silenus* (*Simia silenus*), *Simia sylvanus* (*Simia inuus*), *Ovis ammon*, *Camelus bactrianus*, *C. dromedarius*, *Giraffa* species (*Camelopardalis giraffa*), *Tetraceros quadricornis*, *Alces alces*, *Equus caballus*, *E. zebra*, *E. asinus*, *Tapirus indicus*, *Canis familiaris*, *Felis catus* (*F. c. domestica*), *F. pardus*, *Macropus major*, *Sciurus vulgaris*, *Mungos ichneumon* (*Herpestes ichneumon*), *Simia sylvanus* (*Inuus ecaudatus*), *Macropus giganteus*, *Ovis argali*, *Tapirus americanus*, *Oryctolagus cuniculus* (*Lepus cuniculus*).

Location.—In small intestine of primary host. In practically every organ and tissue of the secondary hosts.

Localities.—Cosmopolitan.

Life history.—The eggs produced by the adult worm in the intestine of the primary host pass out and are ingested by the secondary host in contaminated food or water, as a rule. In the digestive tract the embryo escapes from the shell and makes its way into the tissues. Here it develops into the larval stage, a bladderworm which may attain the size of a child's head, commonly called an echinococcus or hydatid, and known under numerous scientific names, largely based on morphological variations or hosts, and characterized by the formation of a laminated external layer and a delicate internal germinal layer. As a defense reaction against unfavorable conditions, the internal germinal membrane or scolices derived from it may give rise to internal daughter bladders, while proliferative elements in the cyst wall may form external daughter bladders. Daughter bladders may form grand-daughter bladders and any bladder of the series may form brood capsules containing scolices. When the larvae are ingested by the primary host, the heads contained in these brood capsules develop segments and form the strobilate worm.

This tapeworm must be comparatively common in dogs in some places in the United States, as the larval worms are not infrequently met with, especially in swine, in the meat inspection service of the United States Bureau of Animal Industry. However, the worm has only been reported by Curtice (1892*g*), who collected it in a dog from the pound in Washington, District of Columbia, and by Welch (1890*a*), who developed the adult worm in the dog as the result of feeding experiments. It has been collected from dogs in Alaska by Doctor Joss of the United States Bureau of Animal Industry, its occurrence here being reported by Ransom (1915).

Family MESOCESTOIDIDAE Fuhrmann, 1907.

Synonym.—Mesocestoidae Ariola, 1899.

Family diagnosis.—Taenioidea: Scolex without rostellum or hooks. Suckers unarmed. A single set of reproductive organs in each segment. Genital pores located on the ventral surface of the segment near the median line. Vagina opens in front of or beside the cirrus pouch. Eggs in gravid segments inclosed in a single thick-walled egg capsule. Adults in mammals and birds.

Type-genus.—*Mesocestoides* Vaillant, 1863.

Subfamily Mesocestoidinae Lühe, 1894.

Subfamily diagnosis.—Mesocestoididae: Characters of the family.

Type-genus.—*Mesocestoides* Vaillant, 1863.

Genus MESOCESTOIDES Vaillant, 1863.

Synonyms.—*Monodoridium* Walter, 1866; *Ptychophysa* Hamann, 1885*a*.

Generic diagnosis.—Mesocestoidinae: Genital pores near the anterior fourth of the ventral surface. The uterus forms an elongated median sac with wavy outline, irregularly constricted at certain points, the single egg capsule forming at the posterior portion of the uterus and of the segment.

Type-species.—*Mesocestoides ambiguus* Vaillant, 1863.

No key has been written for the species of *Mesocestoides*, for the reasons given in the discussion of *M. litteratus*.

MESOCESTOIDES LINEATUS (Goeze, 1782*a*) Railliet, 1893*a*.

Synonyms.—*Taenia lineata* Goeze, 1782*a*; *Halysis lineata* (Goeze, 1782*a*) Zeder, 1803*a*; *Taenia canis lagopodis* Rudolphi, 1810*a*; (?) *Mesocestoides litteratus* (Batsch, 1786*a*) Dolley, 1894*a*; *Taenia pseudoelliptica* Baillet, 1863*a*; *Taenia pseudo-cucumerina* Baillet, 1863*a*; *Ptychophysa lineata* (Goeze, 1782*a*) Hamann, 1885*a*.

Specific diagnosis.—Mesocestoides: The head is 600 to 900 μ in diameter, massive and somewhat flattened anteriorly. The rostellum is replaced by a slight central depression. The suckers are oval and display a widely opened longitudinal aperture. The neck is comparatively short and thick. The strobila measures from 30 cm. to 2.5 meters, and shows a feebly reddish color along the median line. The first segments are very short and indistinct. The following segments become square, with slightly convex lateral borders and with slightly prominent posterior angles (fig. 59). Segments become mature in the middle third of the strobila. The terminal segments measure 4 to 6 mm. long and 2 to 3 mm. wide, are shaped like melon seeds and are swollen in the median line by the ovoid uterine capsule filled with eggs. The male genitalia develop first.

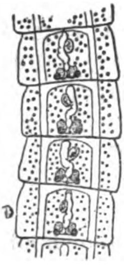

FIG. 59.—MESOCESTOIDES LINEATUS. PORTION OF STROBILA, SHOWING MATURE SEGMENTS. ENLARGED. AFTER NEUMANN, 1896.

Male genitalia.—Testes large and numerous (about 50) and scattered through the segment both median and lateral of the longitudinal excretory canals. Vas deferens describes numerous loops near the mid-dorsal line to the anterior extremity of the segment, where it turns abruptly and enters the cirrus pouch. The cirrus pouch is in the anterior portion of the segment, is well developed and prominent, piriform, and with its posterior aperture opening alternately, usually regularly but at times irregularly, a little to the right and to the left of the median line (fig. 59). The cirrus is from 50 μ to 1 mm. long, swollen at its proximal extremity and commonly found protruded in mature segments.

Female genitalia.—The ovaries are located in the posterior fourth of the segment, and are irregularly spherical to oval. There are two vitellaria which are partly posterior of the ovaries and partly underneath the posterior portion of the ovaries. The vagina extends anteriorly and then returns in a sinuous curve posteriorly from the genital pore and on the side of the median line opposite to the cirrus pouch (fig. 60); it is without a receptaculum seminis. The uterus forms as an elongate sac in the median line, and presents anteriorly a curve to one side, the cirrus pouch always lying in the concavity of this curve, and the curve being alternately, regularly or irregularly, to the right or to the left (fig. 59). The posterior dilation of the uterus transforms into an egg capsule, the remains of the primitive uterus persisting as attached cord-like structures, a short one posteriorly and a longer, sinuous one anteriorly. The

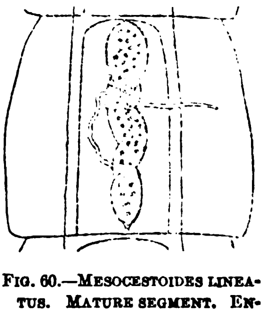

FIG. 60.—MESOCESTOIDES LINEATUS. MATURE SEGMENT. ENLARGED. AFTER NEUMANN, 1896.

eggs are ovoid, 40 to 60 μ long by 35 to 43 μ wide, and have two very thin shells.

Hosts.—Primary: *Canis familiaris*, *C. lagopus*, *Vulpes vulpes* (*V. vulgaris*), *Felis catus* (*F. domestica*), *Lynx nubicus* (*Lynchus nubicus*), *Lynx caracal*, *Felis sylvestris* (*Catus sylvestris*, *F. catus ferus*), ? *Mus musculus*. Secondary: Unknown.

Location.—Small intestine.

Localities.—France, Iceland, Germany, Italy, South Africa.

Life history.—Unknown.

MESOCESTOIDES LITTERATUS (Batsch, 1786a) Dolley, 1894a.

Synonyms.—*Taenia litterata* Batsch, 1786*a*; *Alyselminthus litteratus* (Batsch, 1786*a*) Zeder, 1880*a*; *Halysis litterata* (Batsch, 1786*a*) Zeder, 1803*a*; *Taenia utriculifera* Walter, 1866; *Ptychophysa litterata* (Batsch, 1786*a*) Loennberg, 1896*a*; *Mesocestoides utriculiferus* (Walter, 1866) Muehling, 1898*b*.

Specific diagnosis.—*Mesocestoides*: See *Mesocestoides lineatus.*

Hosts.—Primary: *Canis familiaris*, *Vulpes vulpes* (*Canis vulpes*, *Vulpes vulgaris*), *Martes foina* (*Mustela foina*), *Canis aureus*, *Felis sylvestris* (*Felis catus*). Secondary: Unknown.

Location.—Small intestine of primary host.

Locality.—Europe (Italy).

Life history.—Unknown.

Setti (1897*b*) notes the fact that a number of prominent helminthologists have regarded *Mesocestoides litteratus* as identical with *Mesocestoides lineatus*, and then takes up the arguments adduced by Zschokke (1888) and Condorelli (1891) and concludes that these two writers are in turn in disagreement as to the specific differences said to exist. He himself finds transitional and variable features in the descriptions and his material, which lead him to conclude that the two species are identical or of only varietal standing. The present writer is in no position to pass on the validity of the two species, but there appear to be no descriptions on which a working key could be constructed at present to differentiate the two species, if there are two. Under the circumstances the two names have been retained, but no attempt has been made to write a specific diagnosis, as any that have been seen would vary in no tangible essential feature from that of *M. lineatus.*

Family HYMENOLEPIDIDAE Railliet and Henry, 1909.

Synonyms.—Hymenolepidae Ariola, 1899; Echinocotylidae Ariola, 1899; Dilepinidae Fuhrmann, 1907.

Family diagnosis.—Taenioidea: Scolex with an armed rostellum or without rostellum. Hooks on rostellum not hammer-shaped. Suckers usually unarmed. A single, or less frequently a double, set of reproductive organs in each segment. Genital pores marginal and bilateral, unilateral, or regularly or irregularly alternate. Eggs with thin transparent shells. Adults in mammals, birds, reptiles, and amphibia.

Type-genus.—Hymenolepis Weinland, 1858*a*.

Subfamily DIPYLIDIINAE Stiles, 1896.

Synonyms.—Rhynchotaenia Diesing, 1850*a*; Malacolepidota Weinland, 1858*a*; Cystoideae Leuckart, 1863; Cystoidei Leuckart, 1886; Cystoidotaeniae Railliet, 1885*a*; Microtaeniae Claus, 1891; Dipylidinae Railliet, 1896; Hymenolepinae Perrier, 1897*a*; Dilepininae Fuhrmann, 1907; Dilepidinae Railliet and Henry, 1909.

Subfamily diagnosis.—Hymenolepididae: Rostellum armed or, less frequently, lacking. Suckers unarmed. A single set or, less frequently, a double set of reproductive organs in each segment. Uterus sac-like, simple or lobulated, or not persistent, breaking down into numerous egg capsules, each containing one or several eggs. Parauterine organs not developed. Adults in mammals, birds, and reptiles.

Type-genus.—Dipylidium Leuckart, 1863.

Genus DIPYLIDIUM Leuckart, 1863.

Synonyms.—Taenia Linnaeus, 1758*a*, part, of authors; *Taenia* (*Dipylidium*) Leuckart, 1863; *Alyselminthus* Weinland, 1858*a*, not Zeder, 1800*a*; *Cryptocystis* Villot, 1882; *Microtaenia* Claus, 1884; *Depylidium* Sonsino, 1895; *Dypilidium* Castellani and Chalmers, 1910; *Dipylidum* Daniels, 1910.

Generic diagnosis.—Dipylidiinae: Rostellum armed with several circlets of hooks which are of rose-thorn shape and usually provided with a discoidal base. Suckers unarmed. A double set of reproductive organs in each segment. Genital pores double and opposite. Testes very numerous, scattered throughout the entire medullary parenchyma. Vas deferens coiled; vesicula seminalis lacking. Gravid segments usually longer than broad. Uterus at first reticular, later breaking up into egg capsules, each containing one or more eggs. Adults in mammals and birds.

Type-species.—Dipylidium caninum (Linnaeus, 1758*a*) Railliet, 1892*v*.

KEY TO SPECIES OF DIPYLIDIUM.

1. Strobila not over 25 mm. long; rostellum with 4 circlets of hooks, the hooks 45 μ long and with a handle and guard; the cirrus pouch opens ventral of the vagina; 1 egg to each capsule............*Dipylidium trinchesei*, p. 69.
Strobila 5 cm. long or longer; hooks rose-thorn-shaped............2.
2. Head with 16 circlets of hooks; strobila 20 to 30 cm. long; 1 egg to each egg capsule............*Dipylidium pasqualei*, p. 71.
Heads with 8 to 14 circlets of hooks............3.

3. Head with 13 or 14 circlets of hooks; strobila 12 to 20 cm. long; 45 to 50 small testes; cirrus pouch 250 to 260 μ long and crossing the longitudinal excretory canals; vitellarium roughly spherical and smaller than the ovarian lobes; 1 large egg, 52 to 53 μ in diameter, in each egg capsule. *Dipylidium chyzeri*, p. 68.

Head with not over 6 rows of hooks; 90 or more testes; 2 or more eggs in each capsule---------- 4.

4. Heads with 6 circlets of hooks; strobila 10 to 23.5 cm. long; 130 to 140 testes; cirrus pouch extends to the longitudinal excretory canals; the median ovarian lobes crescentic, the lateral spherical; the vitellarium reniform and as large as an ovarian lobe; egg capsules with 2 to 15 eggs and at times extending lateral of the longitudinal excretory canals. *Dipylidium sexcoronatum*, p. 65.

Heads with 3 to 5 circlets of hooks; cirrus pouch extends across the excretory canals regularly or occasionally; vitellarium smaller than the ovarian lobes or smaller than the median lobes---------- 5.

5. Head with 5 circlets of hooks; strobila 5 to 11 cm. long; 90 to 100 large testes; cirrus pouch curved, convex posteriorly and extending distinctly across the longitudinal excretory canals; vitellarium smaller than the ovarian lobes; spindle-shaped receptaculum seminis present; vagina opens posterior of the cirrus pouch aperture; eggs 25 μ in diameter. *Dipylidium oerleyi*, p. 63.

Head with 3 to 4 circlets of hooks; strobila 15 to 40 cm. long; 100 to 200 testes; cirrus pouch piriform and extending to, or occasionally across, the longitudinal excretory canals; no receptaculum seminis present, the oviduct showing a compensatory dilation; vagina opens ventral of the cirrus pouch aperture; eggs 43 to 50 μ in diameter----*Dipylidium caninum*, p. 73.

Parts of the above key are based on illustrations where the features in question are not specifically covered in the text, and therefore depend for their reliability on the accuracy of the illustrations and the constancy of the features covered.

DIPYLIDIUM OERLEYI von Rátz, 1900*a*.

Specific diagnosis.—Dipylidium: The head (fig. 61) is broad and club-shaped, and is 330 μ long and 390 μ wide; it tapers anteriorly to form a blunted cone; it is provided with a rostellum 67 μ long and 71 μ wide at the base, conical in shape, with a rounded apex, constantly retracted and lying in a deep depression. The rostellum bears 5 alternating circlets of hooks covering the lower portion of the cone, the tip of the cone being free from hooks; the hooks are of rose-thorn shape, with a somewhat bent ventral root and with a bevel-edged funnel-shaped base, so that the entire hook has the general form of a bent funnel. The rostellum is prolonged posteriorly to form a thick muscular mass, with a neck-like constriction anteriorly and terminating posteriorly in a large thick conical mass. The 4 suckers are oval and but slightly prominent. The neck is short and thick and diminishes in diameter posteriorly. The entire strobila is 5 to 11 cm. long and consists of 70 to 90 segments. The anterior segments are very short. Posterior of these the segments lengthen and become almost square at a distance of 5 to 6 mm. posterior of the head. Posterior of these they become elongate, attaining a maximum length of 4 to 5 mm. and a maximum width of 2 mm. The posterior portion of each segment is longer than its anterior portion and extends a slight distance laterally to form the serrate margin. The terminal gravid segments are pale yellow and are sometimes piriform, the anterior portion being constricted and the posterior portion expanded. The genital primordia develop comparatively early and are recognizable 1 mm. behind the head in the twenty-fifth to the twenty-seventh segments, the male genitalia being the first to become visible. In mature segments (fig. 62) the genital pore lies posterior of the middle of the lateral margin, and is located in an inconspicuous depression. The excretory canals are visible just posterior of the head and become larger and wavy in the more developed segments.

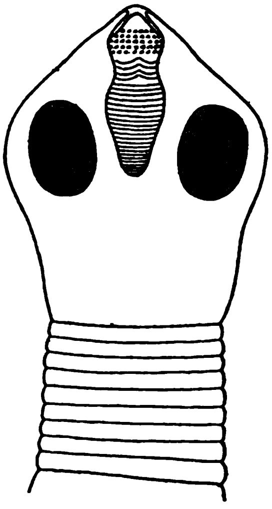
FIG. 61.—DIPYLIDIUM OERLEYI. HEAD. ENLARGED. AFTER VON RÁTZ, 1900a.

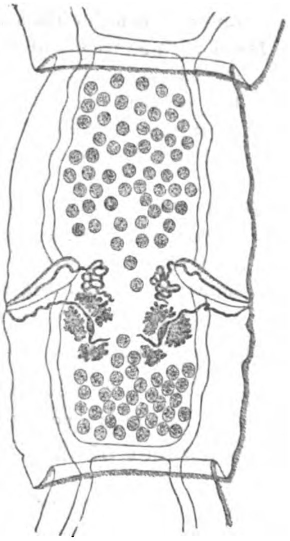
FIG. 62.—DIPYLIDIUM OERLEYI. MATURE SEGMENT. ENLARGED. AFTER VON RÁTZ, 1900a.

Male genitalia.—There are about 90 to 100 large testes, which fill the anterior and posterior portion of the field between the longitudinal excretory canals; there are but few testes in the portion of the field near the female genitalia. The very much convoluted and looped vas deferens lies anterior of the ovaries and meets the cirrus pouch on the median side of the longitudinal canals. The cirrus pouch is elongate piriform, with the dilation toward the median portion of the segment; it is somewhat curved, with the convexity of the curve directed toward the posterior portion of the segment, and extends anteriorly and medially across the longitudinal canals.

Female genitalia.—The ovaries are in the middle field of the segment and for the most part are posterior of the genital pores. They are each composed of two lobes separated by the vagina, and each irregularly lobulated. The vitellaria are smaller than either of the two portions of each ovary and are likewise irregularly lobulated, and are situated just posterior of the ovaries. The small shell gland is situated around the oviduct. The opening of the vagina is immediately behind that of the cirrus pouch; from here the vagina extends medially in a somewhat sinuous and curving course and swings posteriorly between the two lobes of the nearest ovary to a spindle-shaped receptaculum seminis in the comparatively wide clear field between these lobes. The uterus is only recognizable in the most developed segments in the form of a reticulum lying between the testes. When full of eggs it bulges out in part and forms the egg capsules. The eggs lie in groups in these capsules and are round and 25 μ in diameter.

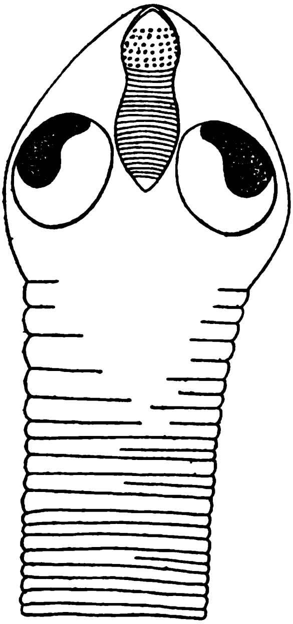

FIG. 63.—DIPYLIDIUM SEXCORONATUM. HEAD. ENLARGED. AFTER VON RÁTZ, 1900*a*.

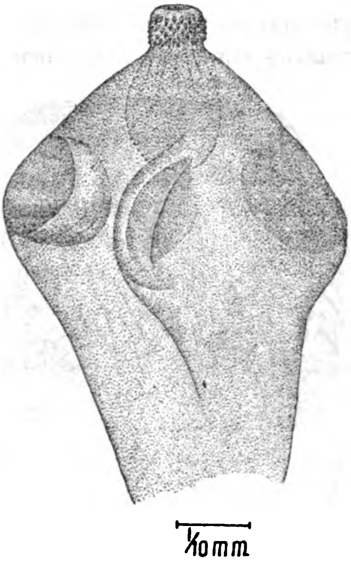

FIG. 64.—DIPYLIDIUM SEXCORONATUM. HEAD.

Host.—Primary: *Felis catus* (*F. domestica*).

Location.—Small intestine.

Locality.—Hungary (Budapest).

Life history.—Unknown.

I am indebted for the translation of von Rátz's Hungarian description of this and the next species to the courtesy of Dr. Adolph Eichhorn, formerly of the United States Bureau of Animal Industry.

DIPYLIDIUM SEXCORONATUM von Rátz, 1900*a*.

Specific diagnosis.—*Dipylidium:* The head (figs. 63 and 64) is 330 μ long and 370 μ wide, oval in shape, and terminating conically anteriorly. The conical rostellum (fig. 65) is usually retracted, and is 46 µ long and 54 µ wide at the base. The middle and lower thirds of the rostellum are covered with 6 circlets of hooks, which lie close together and almost cover this portion of the rostellum. My American specimens, as shown in figure 65, have 100 or more hooks. The hooks are rose-thorn shaped, those of the most anterior row being the largest and those of the posterior row being the smallest. The rostellum is continued posteriorly as a muscular mass, of which the anterior portion is thinner and the posterior portion is oval. The suckers are slightly prominent and are elongated longitudinally. The neck is very short and is scalloped by an imperfect transverse segmentation at the margin, these imperfect segmentations finally becoming complete and forming the more anterior segments. The entire strobila is about 10 to 23.5 cm. long. The anterior segments are short and are followed by longer ones which become almost square about 1.5 cm. posterior of the head. About the middle of the strobila they are elongated longitudinally, becoming several times longer than wide. The longest segments are about at the union of the middle and posterior thirds of the strobila, and are 6 to 7 mm. long and 1 to 1.5 mm. wide. Posterior of this point they become shorter, wider, and thicker. The enlarged posterior margin of each segment forms a sort of collar about the smaller anterior margin of the succeeding segment. The primordium of the genital pore forms on young segments as a small protuberance, but in more mature segments this disappears and leaves instead a small depression, which is posterior of the middle of the lateral margin of the segment. The longitudinal excretory canals are very prominent, even in young segments, and later show as wide wavy canals; the transverse canals are likewise very wide and are situated at the union of adjacent segments.

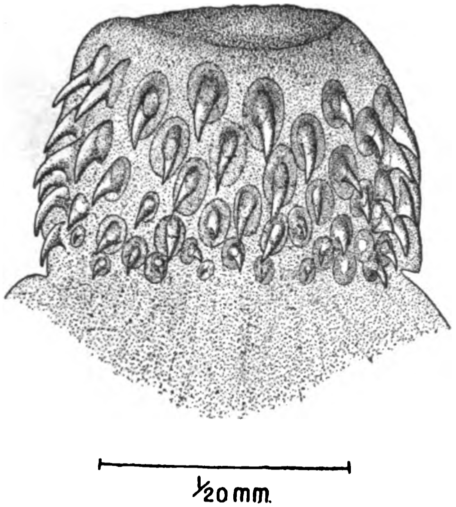

FIG. 65.—DIPYLIDIUM SEXCORONATUM. ROSTELLUM.

Male genitalia.—The testes (fig. 66) are spherical, about 130 to 140 in number, and occupy nearly all the space between the longitudinal canals not occupied by the other genitalia; they are especially numerous in the middle and posterior portions of this field and leave a clear area in the anterior portion of the segment. The vas deferens is much looped; it lies just anterior of the ovary and pursues a fairly straight course, aside from the loops, to the cirrus pouch. In young segments the cirrus pouch has the shape of an hourglass, widened proximally and distally and constricted medially; in mature segments it is piriform. It extends to the longitudinal excretory canal, but does not cross it.

Female genitalia.—Each ovary (fig. 66) consists of two distinct lobes, each of a loose, irregular structure, the lobe toward the median side of the segment following the convexity of the curve of the vagina in a roughly crescentic outline, and the one toward the lateral side of the segment lying in the concavity of the curve of the vagina in a roughly circular outline. The ovaries lie mostly posterior of the genital pores. The vitellaria are relatively compact reniform structures lying posterior of the ovaries, and each vitellarium is about as large as one of the two principal parts of each ovary. The shell-gland is a relatively large and compact reniform structure between the ovary and the vitellarium and displaced toward the median line. In young segments the vagina passes almost straight medially; in mature segments it is very slightly wavy in the lateral field of the segment and then curves posteriorly after crossing the excretory canal to form a spindle-shaped receptaculum seminis in the very narrow curved field between the two principal portions of each ovary. The uterus is only seen in later segments and is a fine tubular reticulum branching through the median field and especially distinct between the (? female) genitalia and posterior of these. After the constriction of some parts it forms egg capsules containing 2–3–8–15 eggs to a capsule. The eggs are spherical and are 21 μ in diameter. The densest clumps of eggs are posterior of the oviducts, where the capsules form almost a connected network and may lie lateral of the longitudinal excretory canals.

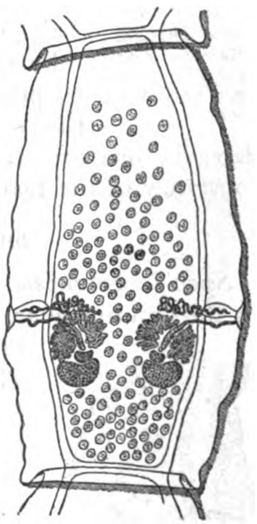

Fig. 66.—Dipylidium sexcoronatum. Mature segment. Enlarged. After von Rátz, 1900a.

Host.—Primary: *Canis familiaris.*

Location.—Small intestine.

Localities.—Hungary (Budapest); United States (Bethesda, Maryland; Detroit, Michigan).

Life history.—Unknown.

This species, reported for the first time from the United States by Hall (1917), the second record of its occurrence, was collected by the writer from a dog shipped from Fallon, Nevada, in 1910, and examined post mortem for parasites in 1913. In view of what we know of the length of life for dog cestodes, it is unlikely that the worms found were present when the dog arrived at Bethesda, Maryland. However, it is possible that the dog was infested with worms of this species and that the worms found were some from infestation due to eating intermediate hosts, presumably fleas or lice, as in *D. caninum*, which had been infected from the original worms. It is also possible that the infestation originated entirely at Bethesda. A number of specimens were collected at Detroit from dogs which undoubtedly became infested in that locality.

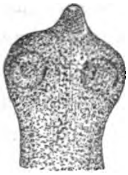

FIG. 67.—DIPYLIDIUM CHYZERI. HEAD. ENLARGED. AFTER VON RÁTZ, 1897*b*.

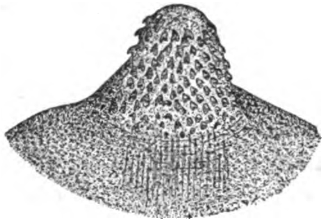

FIG. 68.—DIPYLIDIUM CHYZERI. ROSTELLUM. ENLARGED. AFTER VON RÁTZ, 1897*b*.

Part of the specific description is based on von Rátz's illustrations, and so depends for its reliability on the accuracy of the illustrations and the constancy of the features illustrated.

DIPYLIDIUM CHYZERI von Rátz, 1897*b*.

Specific diagnosis.—Dipylidium: The head (fig. 67) is small, 352 to 432 μ in diameter, and conical. The rostellum (fig. 68) is conical, 112 μ long, and terminates in a rounded tip. There are 13 to 14 circlets of hooks, forming diagonal rows toward the tip of the rostellum; these hooks are of rose-thorn shape with a flat basal portion attached at an angle. This basal part is formed by a long flat plate, thinned at both ends and bent at the anterior end, and the hook length proper is not over two-thirds the length of this basal portion. The largest hooks are near the tip of the rostellum, where they are 14 μ long and 5.5 μ thick; nearer the base they are 10.5 by 5 μ; and those at the base are still smaller. The strobila is 12 to 20 cm. long and attains its maximum width, 1.4 to 1.6 mm., near the middle, at which point the segments are almost quadrate. The free gravid segments are 4.5 mm. long and 700 to 750 μ wide. The genital pores are anterior of the middle of the lateral margin of the segment. The longitudinal and transverse excretory canals are of about the same width.

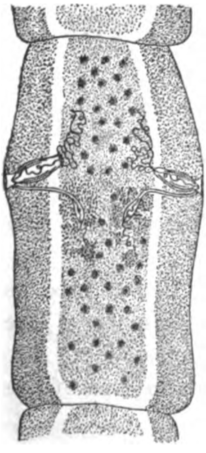

FIG. 69.—DIPYLIDIUM CHYZERI. MATURE SEGMENT. ENLARGED. AFTER VON RÁTZ, 1897*b*.

Male genitalia.—The testes (fig. 69) are small, 45 to 50 in number, and are scattered at comparatively wide intervals throughout the segment. There are apparently two or three vasa deferentia on each side of the segment (according to the illustration) and they extend in the median field parallel to the longitudinal excretory canals and just median of the canals. The cirrus pouch is large, 250 to 260 μ long by 120 to 130 μ wide, and piriform, and extends across the longitudinal canals into the median field.

Female genitalia.—Each ovary (fig. 69) is composed of two principal lobes, which are irregularly lobate elongated structures pressing close on each side of the vagina and receptaculum seminis, those on the median side lying on the convexity of the curve of the vagina and receptaculum seminis and having a roughly crescentic outline. The ovaries lie mostly posterior of the genital pores. The vitellarium is a roughly spherical mass lying posterior of the ovary and is smaller than either of the two main ovarian lobes. The shell-gland is very small and is between the vitellarium and the ovary. There is a large receptaculum seminis. Each of the uterine capsules contains only one large egg, 52 to 53 μ in diameter.

Host.—*Felis catus* (*Felis domestica*).

Location.—Intestine.

Locality.—Probably Hungary.

Life history.—Unknown.

Part of the above description is based on von Rátz's illustrations and so depends on the accuracy of the illustrations and the constancy of the features for its reliability, as noted in the foregoing species.

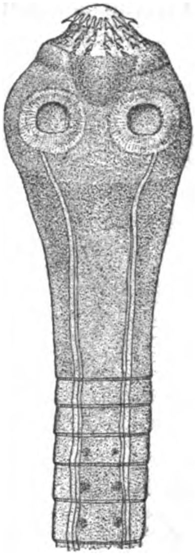

FIG. 70.—DIPYLIDIUM TRINCHESEI. ANTERIOR EXTREMITY OF STROBILA. ENLARGED. AFTER DIAMARE, 1893*b*.

DIPYLIDIUM TRINCHESEI Railliet, 1893*a*.

Synonym.—*Dipylidium trinchesii* Diamare, 1892*a*.

Specific diagnosis.—*Dipylidium:* Head (fig. 70) globular, with a relatively large imbutiform rostellum, the spherical anterior portion provided with four circlets of about 80 hooks (fig. 71), the largest hooks being in the anterior circlet and the smallest in the posterior circlet, the largest attaining a length of 36 μ and a width of 47 μ; the hooks of the first three rows are provided with a distinct handle and guard and a strongly curved blade. The suckers are orbicular and prominent. The neck is short. The entire strobila is very short, attaining a length of about 25 mm. The first segments are rectangular, with rounded margins. The genital primordia appear in the second or third segment and mature genitalia are present in the tenth segment. The mature segments (fig. 72) are vase-shaped. Terminal gravid segments (fig. 73) become four times as long as wide. The genital pores are considerably anterior of the middle of the lateral margin of the segment, their position marking the point of maximum width of the vase-shaped segment.

Male genitalia.—Testes, judging from the figure, are few in number and scattered through the median field. Vas deferens in loops directed toward the anterior portion of the segment, and pigmented black. Cirrus pouch cylindrical, somewhat twisted, and opening ventral of the vagina; it apparently crosses the longitudinal canals in a wide curve, the convexity of the curve directed posteriorly.

Female genitalia.—Ovaries compact and globular to reniform. Vitellaria spherical. The vagina opens dorsal of the cirrus pouch and passes medially to a large receptaculum seminis between the ovarian lobes. The egg capsules contain one egg each.

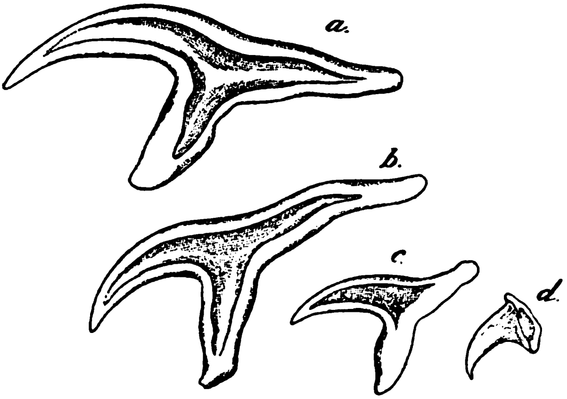

FIG. 71.—DIPYLIDIUM TRINCHESEI. HOOKS. *a*, HOOK FROM FIRST OR MOST ANTERIOR ROW; *b*, FROM SECOND ROW; *c*, FROM THIRD ROW; *d*, FROM FOURTH ROW. ENLARGED. AFTER DIAMARE, 1893*b*.

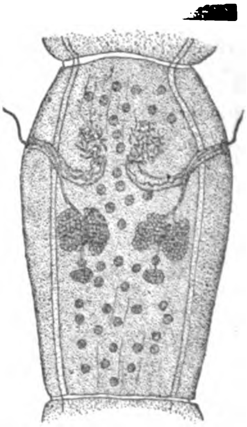

FIG. 72.—DIPYLIDIUM TRINCHESEI. MATURE SEGMENT. ENLARGED. AFTER DIAMARE, 1893*b*.

Hosts.—Primary: *Felis catus* (*F. domestica*). Secondary: *Zamenis viridiflavus*.

Location.—In small intestine of primary host. In cysts in the intestinal wall of the secondary host.

Localities.—Italy (Naples); Egypt (Alexandria).

Life history.—Diamare believes that *Cysticercus acanthotetra* Parona (1887) found in Sardinia in cysts in the intestinal wall of the snake *Zamenis viridiflavus*, is the larva of *Dipylidium trinchesei*. If this theory is correct, the worm is an accidental parasite of the cat, as cats are not generally in the habit of eating snakes, as Blanchard (1907) has noted. It might also be urged that there is probably comparatively little opportunity for the ingestion of the eggs of the adult worm by a secondary host like the snake except by ingesting the primary host, a thing which might readily occur if the usual primary host is some small mammal. This would be a quite unusual and interesting case, where the infestation with a larval stage depended on the ingestion of a primary host by a secondary host. But in view of the fact that the secondary host must in turn be eaten by the primary host, and in view of the fact that the only known intermediate hosts of a species of *Dipylidium* are insects, Diamare's hypothesis needs experimental verification before it can be accepted.

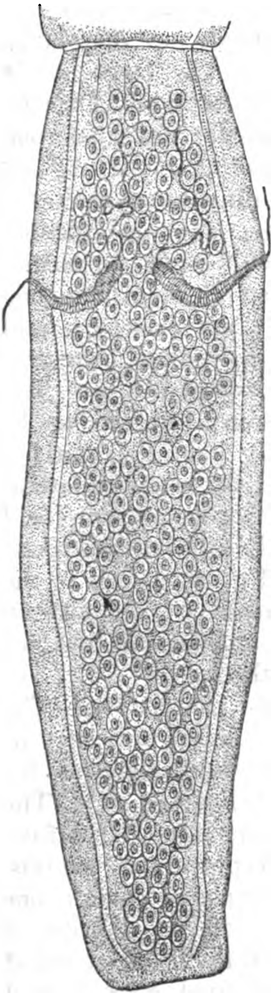

Fig. 73.—Dipylidium trinchesei. Gravid segment. Enlarged. After Diamare, 1893b.

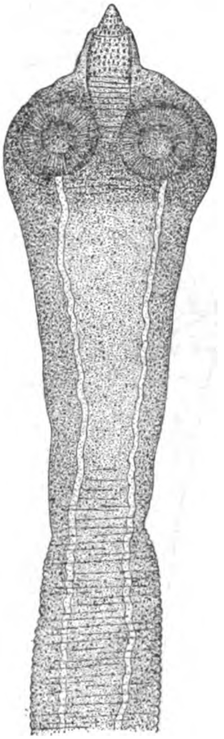

Fig. 74.—Dipylidium pasqualei. Anterior portion of strobila. Enlarged. After Diamare, 1893b.

Diamare (1892*a*) first gave the number of hooks in this species as 65, but later (Diamare, 1893) gave the number as about 80.

DIPYLIDIUM PASQUALEI
Diamare, 1893a.

Specific diagnosis.—*Dipylidium:* Head (fig. 74) globular, 800 to 900 µ in diameter. The elongate, claviform rostellum is acuminate anteriorly and is armed with 16 circlets of hooks which have a discoid, almost circular base, and are 7 µ long and 8 µ wide, those of the last row being smaller. The suckers are rounded. The strobila is from 20 to 30 cm. long or longer. The genitalia develop rather late and mature segments (fig. 75) are still rather short and quadrilateral. The genital pore

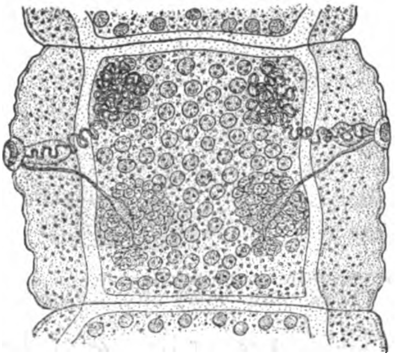

Fig. 75.—Dipylidium pasqualei. Mature segment. Enlarged. After Diamare, 1893b.

is anterior of the middle of the lateral margin of the segment, and the cirrus pouch and vagina open at the same level. Gravid segments (fig. 76) are lanceolate in outline. The longitudinal excretory canals are very large, three times as large as in *Dipylidium caninum.* Calcareous corpuscles are numerous.

Male genitalia.—Judging from the illustration, the testes are large, few in number (about 50?) and uniformly distributed through the median field, not present lateral of the longitudinal excretory canals or of the ovaries. The vas deferens appears to be moderately looped distally, and coiled in the antero-lateral corner of the median field proximally. The cirrus pouch is figured as extending to the lateral canals or lying entirely lateral of these canals, but not crossing them.

Female genitalia.—The ovary is bilobed and branching. The vitellarium is bilobed. Shell gland (?). The vagina opens into a large fusiform receptaculum seminis. The egg capsules contain one egg each, and are distributed throughout the fields lateral of the longitudinal canal as well as median of it.

Host.—Primary: *Felis catus* (*F. domestica*).

Location.—Small intestine.

Locality.—Egypt (Alexandria).

Life history.—Unknown.

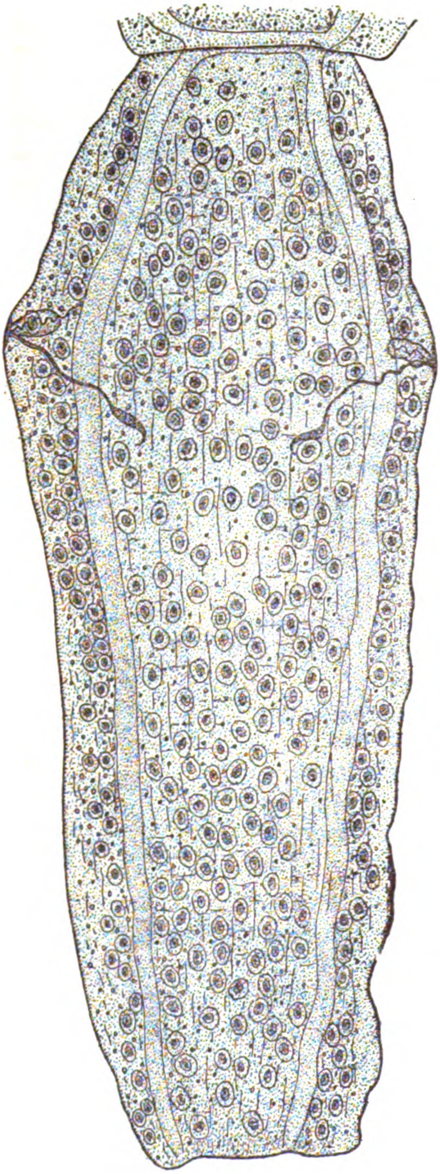

FIG. 76.—DIPYLIDIUM PASQUALEI. GRAVID SEGMENT. ENLARGED. AFTER DIAMARE, 1893*b*.

The figures for the size of the head are based on Diamare's statement that the head is twice as large as that of *D. echinorhynchoides.* The dimensions of the hooks are taken from Blanchard (1907).

DIPYLIDIUM CANINUM (Linnaeus, 1758a) Railliet, 1892v.

Synonyms.—Taenia canina Linnaeus, 1758a; *T. moniliformis* Pallas, 1781, not Batsch, 1786a; *T. cucumerina* Bloch, 1782a; *T. cateniformis* Goeze, 1782a; *T. elliptica* Goeze, 1782a; *T. ellyptica* Batsch, 1786a; *T. cateniformis canina* Linnaeus of Gmelin, 1790a; *T. c. felis* Gmelin, 1790a; *Alyselminthus ellypticus* (Batsch, 1786a) Zeder, 1800a; *Taenia cuneiceps* Zeder, 1800a; *Halysis ellyptica* (Batsch, 1786a) Zeder, 1803a; *Tenia canina* (Linnaeus, 1758a) van Beneden, 1861a; *T. cucumerina* (Bloch, 1782a) van Beneden, 1861a; *Taenia* (*Dipylidium*) *cucumerina* Bloch of Leuckart, 1863; *Cryptocystis trichodectis* Villot, 1882; *Dypylidium caninum* (Linnaeus, 1758a) von Rátz, 1897.

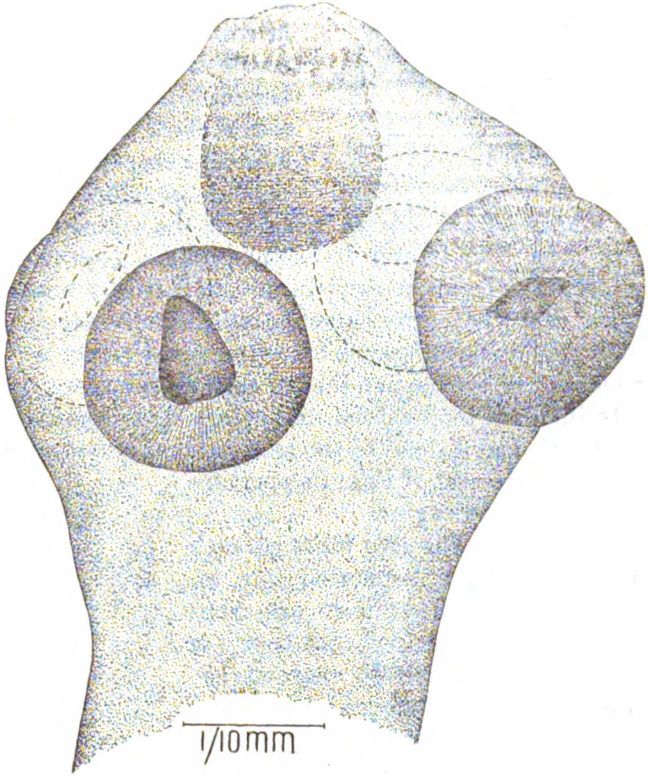

FIG. 77.—DIPYLIDIUM CANINUM. HEAD.

Specific diagnosis.—Dipylidium: Head (fig. 77) small and rhomboidal, 350 to 460 μ in diameter in a state of contraction. Rostellum claviform, 185 μ long in a state of complete evagination, 110 to 120 μ wide, and capable of retraction into a deep cephalic infundibulum. It is armed with three or, usually, four circlets of about 60 hooks (fig. 78) of rose-thorn shape; the hooks of the most anterior row are the larger, 12 to 15 μ long, and those of the most posterior row the smallest, 5 to 6 μ long. The hooks are very easily lost and specimens are frequently found without any hooks or with only a few still in place. The suckers are very large and ellipsoidal. The neck is short and thin. The strobila is 15 to 40 cm. long and is composed of 80 to 120 segments. The segments are at first very short, then trapezoidal, and finally much longer than wide. Genitalia develop later. Mature and gravid segments (figs. 79 and 80) have distinctly convex lateral margins, giving the segments the characteristic cucumber-seed shape. Gravid segments are 8 to 11 mm. long and 1.5 to 3 mm. wide, and are often reddish in color. Genital pores are in the middle of the lateral margin of the segment or at times posterior of this. The lateral excretory canals are quite prominent.

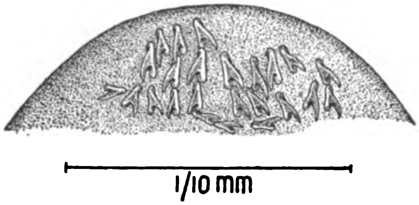

FIG. 78.—DIPYLIDIUM CANINUM. HOOKS.

Male genitalia.—Testes numerous, 100 to 200 in number, and occupying most of the parenchyma not occupied by the female genitalia. The vas deferens in mature segments extends anteriorly and laterally from the vicinity of the median lobe of each uterus, toward the cirrus pouch, only the final loop extending posteriorly to the cirrus pouch. The cirrus pouch may extend to the longitudinal excretory canal, but is usually entirely lateral of this; its aperture is dorsal to that of the vagina.

Female genitalia.—The two lobes of each ovary are very distinct, separated into lobules, and loosely formed; they are commonly said to be wing-shaped, but they are very irregular and difficult to characterize. The vitellarium is some distance posterior of the ovary and is irregular and very loosely lobulate; it is smaller than the median ovarian lobe, and equal to or smaller than the lateral lobe. The shell gland is between the ovary and the vitellarium. The vagina extends between the two lobes of each ovary and does not dilate to form a receptaculum seminis. The oviduct is dilated to compensate for the absence of a receptaculum seminis. Each egg capsule contains from 5 to 20 globular eggs, 43 to 50 μ in diameter, with thin shells and with an onchosphere 25 to 36 μ in diameter, provided with hooks 11 to 14 μ long.

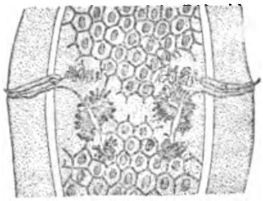

FIG. 79.—DIPYLIDIUM CANINUM. MATURE SEGMENT. × 12.5. AFTER NEUMANN IN RAILLIET, 1893*b*.

Hosts.—Primary: *Canis familiaris*, *C. mesomelas*, *Felis sylvestris* (*F. catus*), *F. catus* (*F. catus domestica*), *F. maniculata*, *Homo sapiens*. Secondary: *Trichodectes canis*, *Ctenocephalus canis*, *Pulex irritans*.

Location.—In small intestine of primary host. In the visceral cavity of secondary hosts.

Locality.—Cosmopolitan.

Life history—Eggs developed by the adult worm in the intestine of the primary host were once supposed to be ingested by the secondary hosts either on the skin of the primary host, where it was soiled by feces, or from the gravid segments direct. Melnikov (1869) has shown that *Trichodectes* eats the eggs as it feeds on the skin of the dog, but Joyeux (1916) has demonstrated that fleas ingest eggs while the fleas are larvae feeding on debris, the adult flea being unable to ingest a tapeworm egg. In the digestive tract of the secondary host the embryo escapes and makes its way to the visceral cavity where it develops into the tiny larva, called *Cryptocystis trichodectis*. When lice and fleas infested with these larvae are ingested by the primary host, the larval head passes to the intestine and gives rise to the strobilate worm.

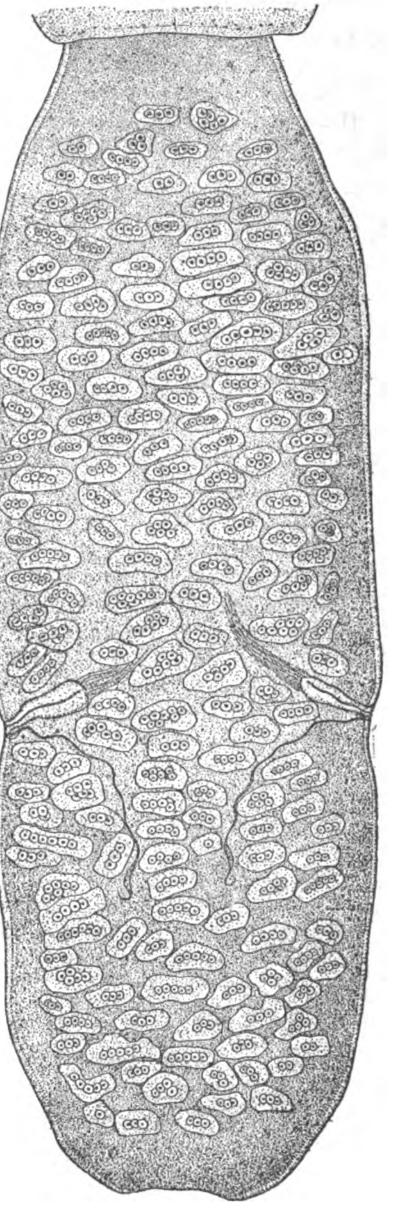

FIG. 80.—DIPYLIDIUM CANINUM. GRAVID SEGMENT. ENLARGED. AFTER DIAMARE, 1893*b*.

SYNOPTICAL KEY.

The tapeworms of the dog, cat, and some related carnivores may be separated into the following groups and genera by the use of the appended key from Hall (1916*b*), (corrected for stenographic errors involving *Dipylidium pasqualei* and *D. chyzeri*), which is intended to designate the relations and importance of the tapeworms as well as to distinguish them from one another. The key does not cover the species in the family Diphyllobothriidae.

1. Head provided with two slit-like suckers, and segments with a rosette-shaped uterus having a special aperture in the midventral line for the discharge of eggs. Larvae in fish________________________Diphyllobothriidae, p. 4.
   Head with four cup-shaped suckers____2.
2. Follicular yolk glands in the lateral fields. Accidental in the dog.
   Ophiotaenia punica, p. 4.
   Yolk glands in median field, never in lateral fields______________________3.
3. Genital pore located on the ventral surface near the median line. Eggs in gravid segments, contained in a single thick-shelled egg capsule.
   Mesocestoides lineatus, Mesocestoides litteratus
   (probably identical species), pp. 59, 61.
   Genital pore lateral. Eggs in gravid segments, contained in a uterus or in numerous egg capsules____4.
4. Usually large forms. Genital pores irregularly alternate. Rostellum usually well developed and usually armed with a double crown of hooks, rarely with a single (?) crown of hooks or unarmed. Suckers unarmed. Uterus with a median stem and lateral branches. Eggs thick shelled__Taeniidae, 5, p. 5.
   Usually small forms. Genital pores single or double; if single, regularly or irregularly alternate. Rostellum present or absent; if present, armed with one to numerous rows of hooks. Suckers armed or unarmed. Uterus saclike and persistent, or a single or double uterus with one or several parauterine organs, to which the eggs pass in the final stage of development. Eggs with thin, transparent shells____________Hymenolepididae, 19, p. 61.
5. Strobila less than 1 cm. long and composed of a head and 3 segments, only one of the segments being gravid at a time. Lateral uterine branches often quite indistinct. Yolk-gland globular. Larval stage an echinococcus with thick laminated wall, and developing brood capsules containing the larval scolices___________________________*Echinococcus granulosus*, p. 56.
   Strobila at least several centimeters long and composed of a head and numerous segments, from 10 to hundreds, with a number of segments usually gravid at one time. Lateral uterine branches usually distinct, at least in early stages of formation. Yolk gland posterior of ovaries and elongate or triangular, with one side parallel to the posterior margin of the segment. Larval stage a bladderworm with thin walls and never containing brood capsules____6.
6. Strobila without a neck and with a double circlet of many and very large hooks, the large hook over 300 μ long, or with only a single circlet of hooks (?). Bladderworms, so far as known, with a small caudal bladder and with a long segmented structure connecting the bladder and head. Parasitic in Felidae____7.
   Strobila with a neck and with a double circlet of hooks, the large hook less than 300 μ long. Bladderworms with a caudal bladder, a head and a moderate-sized neck. Parasitic in Canidae_________________________________10.
7. Rostellum with a single circlet of hooks of rose-thorn-shape. Reported from *Lynx lynx* (*Felis lynx*)_____________________*Taenia monostephanos*, p. 38.
   Rostellum with a double circlet of hooks, the large hooks over 300 μ long__8.
8. Large hooks 60 to 74 in number; 320 to 355 μ long; the large hooks arranged so as to form in effect 2 circlets of large hooks, being alternately nearer to the center of the rostellum and farther from it.
   Taenia macrocystis, p. 12.
   Large hooks not over 60 in number_______________________________________9.

9. Hooks 26 to 52 in number. Well developed sphincter vaginae.
Taenia taeniaeformis, p. 9.

Hooks 28 to 60 in number. Probably identical with the preceding species.
Taenia laticollis, p. 8.

10. Vagina with a reflex curve near the lateral excretory canals. Large hooks 135 to 180 μ long and usually with a sinuous handle.
Multiceps, 11, p. 39.

Vagina without a reflexed curve near the lateral canals.....*Taenia*, 13, p. 6.

11. Mature segments wider than long; the lateral margins of each segment often scalloped as a result of a number of constrictions or furrows passing around the segment transversely; the posterior margin of each segment prolonged posteriorly to overlap the anterior margin of the succeeding segment like a cuff. Small hook with short, blunt curving handle. Genital papilla very narrowly conical and in posterior half of segment, often near posterior margin. Larva a coenurus with daughter bladders, found in the connective tissue of rodents (including the Lagomorpha).
Multiceps serialis, p. 51.

Mature segments longer than broad; the lateral margins of each segment smooth and not scalloped; the posterior margin of each segment prolonged very little or not at all to form a projection over the following segment. Small hooks with long slender handle. Genital papilla posterior of middle of segment but never near posterior margin. Larva a coenurus without daughter bladders, found in ungulates, especially ruminants ....12.

12. Small hook with long curving handle terminating in a blunt distal extremity. Large hook with tapering handle with sinuous outline. Testes do not extend posterior of the ovaries to the vicinity of the vitellarium or between the vitellarium and the ovaries. Larva a coenurus in the central nervous system of ungulates, especially ruminants.
Multiceps multiceps, p. 40.

Small hook with long straight handle terminating in a blunt distal extremity. Large hook with the handle not tapering, and either straight and blunt or bent dorsally just at the tip. Testes extend posterior of the ovaries, almost to the vitellarium and between the vitellarium and the ovaries. Larva a coenurus in the central nervous system, lungs, parenchymatous organs and connective tissue of ruminants.
Multiceps gaigeri, p. 45.

13. Forms in which the vagina crosses the ovary on the pore side in some segments, and forms in which the very large genital papilla is practically as long as the margin of the narrow segments. Bladderworms in the musculature of food animals...14.

Forms in which the vagina does not cross the ovary on the pore side, and in which the genital papilla is never nearly as long as the margin of the segments...15.

14. Gravid uterus with 20 to 25 lateral branches on each side of the median stem. Vagina crosses the ovary on the pore side in some segments. Genital papilla much shorter than the segment margin. Bladderworm in musculature of sheep..................................*Taenia ovis*, p. 32.

Gravid uterus with not over 10 lateral branches on each side of the median stem. Vagina does not cross the ovary on the pore side of the segment. Genital papilla practically as long as the lateral margin of the narrow segments. Bladderworm in the musculature of reindeer.
Taenia krabbei, p. 36.

15. Forms with the hooks from 170 to 294 μ long. Bladderworms attached to omenta, mesenteries, or peritoneal serosa .... 16.

Forms with the large hooks 135 to 145 μ long. Probably accidental parasites of the dog .... 17.

16. Large hooks 225 to 294 μ long. Testes extend posterior of the vitellarium. Mature segments approximately square. Gravid segments with 8 to 14 lateral branches on each side. Vagina only slightly dilated and curved near margin of segment. Bladderworm in rabbits, rarely in mouse or beaver .... *Taenia pisiformis*, p. 22.

Large hooks 170 to 224 μ long. Testes do not extend posterior of the vitellarium. Mature segments distinctly wider than long. Gravid segments with 5 to 10 lateral branches on each side. Vagina forms a sort of crescent by dilation and curvature near lateral margin of segment. Gravid segments with a median longitudinal groove terminating in a notch posteriorly. Bladderworm usually in ruminants, also reported from monkeys and rodents .... *Taenia hydatigena*, p. 28.

17. Guard of small hook twisted so that its flat surface tends to lie in the plane of the blade and handle .... *Taenia brachysoma*, p. 21.

Guard of small hook not so twisted .... 18.

18. Head acorn-shaped, with hooks far anterior of the suckers. Mature segments approximately square .... *Taenia balaniceps*, p. 16.

Head not acorn-shaped, and hooks not far anterior of suckers. Mature segments distinctly broader than long .... *Taenia brauni*, p. 19.

19. Strobila not over 25 mm. long; rostellum with 4 circlets of hooks, the hooks 45 μ long and with a handle and guard; the cirrus pouch opens ventral of the vagina; 1 egg to each egg capsule .... *Dipylidium trinchesei*, p. 69.

Strobila 5 cm. long or longer; hooks rose-thorn-shaped .... 20.

20. Head with 16 circlets of hooks; strobila 20 to 30 cm. long; 1 egg to each egg capsule .... *Dipylidium pasqualei*, p. 71.

Head with 3 to 14 circlets of hooks .... 21.

21. Head with 13 to 14 circlets of hooks, strobila 12 to 20 cm. long; 45 to 50 small testes; cirrus pouch 250 to 260 μ long and crossing the longitudinal excretory canals; vitellarium roughly spherical and smaller than the ovarian lobes; 1 large egg, 52 to 53 μ in diameter, in each egg capsule.
Dipylidium chyzeri, p. 68.

Head with not over 6 rows of hooks; 90 or more testes; 2 or more eggs in each egg capsule .... 22.

22. Head with 6 circlets of hooks; strobila 10 to 23.5 cm. long; 130 to 140 testes, cirrus pouch extends to the longitudinal excretory canals; the median ovarian lobes crescentic, the lateral spherical; the vitellarium reniform and as large as an ovarian lobe; capsules with 2 to 15 eggs and at times extending lateral of the longitudinal excretory canals.
Dipylidium sexcoronatum, p. 65.

Head with 3 to 5 circlets of hooks; cirrus pouch extends across the excretory canals regularly or occasionally; vitellarium smaller than the ovarian lobes or smaller than the median lobes .... 23.

23. Head with 5 circlets of hooks; strobila 5 to 11 cm. long; 90 to 100 large testes; cirrus pouch curved, convex posteriorly, and extending distinctly across the longitudinal excretory canals; vitellarium smaller than the ovarian lobes; spindle-shaped receptaculum seminis present; vagina opens posterior of the cirrus pouch aperture; eggs 25 μ in diameter.
Dipylidium oerleyi, p. 63.

Head with 3 to 4 circlets of hooks; strobila 15 to 40 cm. long; 100 to 200 testes; cirrus pouch piriform and extending to and occasionally across the longitudinal excretory canals; no receptaculum seminis present, the oviduct showing a compensatory dilation; vagina opens ventral of the cirrus pouch aperture; eggs 43 to 50 μ in diameter.
Dipylidium caninum, p. 73.

LIST OF HOSTS.

The writer is indebted to Mr. Gerrit S. Miller, of the United States National Museum, for supplying the correct name in present usage for the various hosts involved in this paper. The names used by various authors which are no longer in good standing are covered in cross references.

MAMMALS.

- MARSUPIALA.
  - MACROPODIDAE.
    - *Macropus giganteus:*
      - *Echinococcus granulosus.*
    - *Macropus major:*
      - *Echinococcus granulosus.*
- INSECTIVORA.
  - TALPIDAE.
    - *Talpa europaea:*
      - *Taenia taeniaeformis.*
- CHEIROPTERA.
  - VESPERTILIONIDAE.
    - *Plecotus auritus:*
      - *Taenia taeniaeformis.*
- CARNIVORA.
  - CANIDAE.
    - *Canis aureus:*
      - *Echinococcus granulosus.*
      - *Mesocestoides litteratus.*
    - *Canis dingo:*
      - *Echinococcus granulosus.*
    - *Canis familiaris:*
      - *Dipylidium caninum.*
      - *Dipylidium sexcoronatum.*
      - *Echinococcus granulosus.*
      - *Mesocestoides lineatus.*
      - *Mesocestoides litteratus.*
      - *Multiceps gaigeri.*
      - *Multiceps multiceps.*
      - *Multiceps serialis.*
      - *Taenia balaniceps.*
      - *Taenia brachysoma.*
      - *Taenia brauni.*
      - *Taenia hydatigena.*
      - *Taenia krabbei.*
      - *Taenia ovis.*
      - *Taenia pisiformis.*

- CARNIVORA—Continued.
  - CANIDAE—Continued.
    - *Canis latrans:*
      - *Taenia pisiformis.*
    - *Canis lupus:*
      - *Echinococcus granulosus.*
      - *Taenia hydatigena.*
    - *Canis mesomelas:*
      - *Dipylidium caninum.*
      - *Echinococcus granulosus.*
      - *Taenia hydatigena.*
    - *Canis nebracensis:*
      - *Multiceps multiceps.*
      - *Taenia pisiformis.*
    - *Canis lagopus.* See *Alopex lagopus.*
    - *Canis vulpes.* See *Vulpes vulpes.*
    - Saddle-backed jackal:
      - *Taenia hydatigena.*
    - *Alopex lagopus:*
      - *Mesocestoides lineatus.*
    - *Vulpes vulgaris.* See *Vulpes vulpes.*
    - *Vulpes vulpes:*
      - *Mesocestoides litteratus.*
      - *Mesocestoides lineatus.*
    - Fox:
      - *Taenia pisiformis.*
    - *Urocyon cinero-argentatus:*
      - *Taenia pisiformis.*
  - MUSTELIDAE.
    - *Galictis* species:
      - *Taenia macrocystis.*
    - *Martes foina:*
      - *Mesocestoides litteratus.*

MAMMALS—Continued.

- CARNIVORA—Continued.
  - MUSTELIDAE—Continued.
    - *Mustela erminea:*
      - *Taenia taeniaeformis.*
    - *Mustela foina.* See *Martes foina.*
    - *Putorius erminea.* See *Mustela erminea.*
  - VIVERRIDAE.
    - *Mungos ichneumon:*
      - *Echinococcus granulosus.*
    - *Herpestes ichneumon.* See *Mungos ichneumon.*
  - FELIDAE.
    - *Felis catus:* (See also *Felis sylvestris.*)
      - *Dipylidium caninum.*
      - *Dipylidium chyzeri.*
      - *Dipylidium oerleyi.*
      - *Dipylidium pasqualei.*
      - *Dipylidium trinchesei.*
      - *Mesocestoides lineatus.*
      - *Taenia hydatigena.*
      - *Taenia pisiformis.*
      - *Taenia taeniaeformis.*
      - *Echinococcus granulosus.*
    - *Felis catus domestica.* See *Felis catus.*
    - *Felis catus ferus.* See *Felis sylvestris.*
    - *Felis concolor:*
      - *Echinococcus granulosus.*
      - *Taenia taeniaeformis.*
    - *Felis domestica.* See *Felis catus.*
    - *Felis eyra:*
      - *Taenia taeniaeformis.*
    - *Felis jaguarundi.* See *Felis yagouaroundi.*
    - *Felis lynx.* See *Lynx lynx.*
    - *Felis macroura:*
      - *Taenia taeniaeformis.*
    - *Felis maniculata:*
      - *Taenia taeniaeformis.*
      - *Dipylidium caninum.*
    - *Felis melivora:*
      - *Taenia taeniaeformis.*
    - *Felis mitis:*
      - *Taenia taeniaeformis.*
    - *Felis onca:*
      - *Taenia taeniaeformis.*
    - *Felis pardus:*
      - *Echinococcus granulosus.*

- CARNIVORA—Continued.
  - FELIDAE—Continued.
    - *Felis* species:
      - *Taenia macrocystis.*
    - *Felis sylvestris:*
      - *Dipylidium caninum.*
      - *Mesocestoides lineatus.*
      - *Mesocestoides litteratus.*
      - *Taenia taeniaeformis.*
    - *Felis* species:
      - *Taenia macrocystis.*
      - *Taenia taeniaeformis.*
    - *Felis tigris:*
      - *Taenia pisiformis.*
    - *Felis yagouaroundi:*
      - *Taenia macrocystis.*
    - *Catus sylvestris.* See *Felis sylvestris.*
    - *Lynx baileyi:*
      - *Taenia macrocystis.*
    - *Lynx canadensis:*
      - *Taenia laticollis.*
    - *Lynx caracal:*
      - *Mesocestoides lineatus.*
    - *Lynx lynx:*
      - *Taenia laticollis.*
      - *Taenia monostephanos.*
    - *Lynx nubicus:*
      - *Mesocestoides lineatus.*
    - *Lynx rufa.* See *Lynx ruffus.*
    - *Lynx ruffus:*
      - *Taenia macrocystis.*
    - *Lynx ruffus maculatus:*
      - *Taenia balaniceps.*
    - *Lynx rufus maculatus.* See *Lynx ruffus maculatus.*
    - *Lynx uenta.* See *Lynx uinta.*
    - *Lynx uinta:*
      - *Taenia taeniaeformis.*
    - *Lynchus nubicus.* See *Lynx nubicus.*
- RODENTIA.
  - MURIDAE.
    - "*Lemmus terrestris:*"
      - *Taenia taeniaeformis.*
    - *Ondatra zibethica:*
      - *Taenia taeniaeformis.*
    - *Fiber zibethicus.* See *Ondatra zibethica.*
    - *Arvicola amphibia.* See *Arvicola amphibius.*
    - *Arvicola amphibius:*
      - *Taenia taeniaeformis.*

MAMMALS—Continued.

RODENTIA—Continued.
  MURIDAE—Continued.
    Arvicola arvalis. See *Microtus arvalis*.
    Microtus arvalis:
      Taenia taeniaeformis.
    Epimys norvegicus:
      Taenia taeniaeformis.
    Epimys rattus alexandrinus:
      Taenia taeniaeformis.
    Epimys rattus rattus:
      Taenia taeniaeformis.
    Mus musculus:
      Mesocestoides lineatus.
      Taenia pisiformis.
      Taenia taeniaeformis.
    Mus rattus alexandrinus. See *Epimys rattus alexandrinus*.
    Mus tectorum. See *Epimys rattus alexandrinus*.
  MYOCASTORIDAE.
    ?Myocastor coypus:
      Multiceps serialis.
    Myopotamus coypus. See *Myocastor coypus*.
  SCIURIDAE.
    Sciurus carolinensis:
      Multiceps serialis.
    Sciurus cinereus. See *Sciurus niger neglectus*.
    Sciurus niger neglectus:
      Taenia hydatigena.
      Multiceps serialis.
    Sciurus vulgaris:
      Echinococcus granulosus.
      Multiceps serialis.
      Taenia hydatigena.
    Sciurus vulpinus. See *Sciurus niger neglectus*.
  CASTORIDAE.
    Mountain beaver:
      Taenia pisiformis.
LAGOMORPHA.
  LEPORIDAE.
    Lepus americanus:
      Taenia pisiformis.
    Lepus brasiliensis. See *Sylvilagus brasiliensis*.
    Lepus californicus:
      Multiceps serialis.

LAGOMORPHA—Continued.
  LEPORIDAE—Continued.
    Lepus californicus deserticola:
      Multiceps serialis.
    Lepus californicus texianus:
      Multiceps serialis.
    Lepus californicus wallawalla:
      Multiceps serialis.
      Taenia pisiformis.
    "*Lepus callotis*" (New Mexico):
      Multiceps serialis.
    Lepus cuniculus. See *Oryctolagus cuniculus*.
    Lepus cuniculus domesticus. See *Oryctolagus cuniculus*.
    Lepus cuniculus ferus. See *Oryctolagus cuniculus*.
    Lepus europaeus:
      Multiceps serialis.
      Taenia pisiformis.
    Lepus mearnsi. See *Sylvilagus floridanus mearnsii*.
    Lepus palustris. See *Sylvilagus palustris*.
    Lepus sylvaticus. See *Sylvilagus floridanus mallurus*.
    Lepus texianus. See *Lepus californicus texianus*.
    Lepus timidus: (See also *Lepus europaeus*.)
      Multiceps serialis.
      Taenia pisiformis.
    Lepus variabilis. See *Lepus timidus*.
    Oryctolagus cuniculus:
      Echinococcus granulosus.
      Multiceps serialis.
      Taenia pisiformis.
    Oryctolagus cuniculus domesticus. See *Oryctolagus cuniculus*.
    Oryctolagus cuniculus ferus. See *Oryctolagus cuniculus*.
    Sylvilagus auduboni baileyi:
      Taenia pisiformis.
    Sylvilagus brasiliensis:
      Taenia macrocystis.
      Taenia pisiformis.

MAMMALS—Continued.

- LAGOMORPHA—Continued.
  - LEPORIDAE—Continued.
    - *Sylvilagus floridanus mallurus:*
      - *Taenia pisiformis.*
    - *Sylvilagus floridanus mearnsii:*
      - *Taenia pisiformis.*
    - *Sylvilagus mallurus.* See *Sylvilagus floridanus mallurus.*
    - *Sylvilagus nuttalli pinetis:*
      - *Taenia pisiformis.*
    - *Sylvilagus palustris:*
      - *Taenia pisiformis.*
- ARTIODACTYLA.
  - CERVIDAE.
    - *Cervus axis.* See *Axis axis.*
    - *Cervus elaphus:*
      - *Taenia hydatigena.*
    - *Cervus unicolor.* See *Rusa unicolor.*
    - *Cervus virginianus.* See *Odocoileus americanus.*
    - *Odocoileus americanus:*
      - *Taenia hydatigena.*
    - *Odocoileus hemionus:*
      - *Taenia hydatigena.*
    - *Mazama rufa:*
      - *Taenia hydatigena.*
    - *Mazama nemorivaga:*
      - *Taenia hydatigena.*
    - *Cariacus macrotis.* See *Odocoileus hemionus.*
    - *Cariacus rufus.* See *Mazama rufa.*
    - *Cariacus simplicicornus.* See *Mazama nemorivaga.*
    - *Alces alces:*
      - *Echinococcus granulosus.*
      - *Taenia hydatigena.*
    - *Alces machlis.* See *Alces alces.*
    - *Rangifer tarandus:*
      - *Taenia hydatigena.*
      - *Taenia krabbei.*
    - *Rangifer terrae-novae:*
      - *Taenia hydatigena.*
    - *Rangifer novae-terrae.* See *Rangifer terrae-novae.*
    - *Tarandus rangifer.* See *Rangifer tarandus.*
    - *Capreolus caprea.* See *Capreolus capreolus.*
- ARTIODACTYLA—Continued.
  - CERVIDAE—Continued.
    - *Capreolus capreolus:*
      - *Taenia hydatigena.*
    - *Axis axis:*
      - *Taenia hydatigena.*
    - *Rusa unicolor:*
      - *Taenia hydatigena.*
    - Duiker:
      - *Taenia hydatigena.*
    - Springbok:
      - *Taenia hydatigena.*
    - Rooi reebok:
      - *Taenia hydatigena.*
    - Columbia deer:
      - *Taenia hydatigena.*
    - Bharrel:
      - *Taenia hydatigena.*
    - Chamois:
      - *Multiceps multiceps.*
    - Mouflon:
      - *Multiceps multiceps.*
    - Gazelle:
      - *Multiceps multiceps.*
    - Antelope:
      - *Multiceps multiceps.*
    - African antelope:
      - *Multiceps multiceps.*
  - BOVIDAE.
    - *Bos taurus:*
      - *Echinococcus granulosus.*
      - *Multiceps multiceps.*
      - *Taenia hydatigena.*
    - *Bubalis* species:
      - *Multiceps multiceps.*
    - *Capra hircus:*
      - *Echinococcus granulosus.*
      - *Multiceps gaigeri.*
      - *Multiceps multiceps.*
      - *Taenia hydatigena.*
      - *Taenia ovis.*
    - *Kobus ellipsiprymus:*
      - *Taenia hydatigena.*
    - *Ozanna equina:*
      - *Multiceps multiceps.*
    - *Hippotragus equinus.* See *Ozanna equina.*
    - *Gazella dorcas:*
      - *Taenia hydatigena.*
    - *Gazella euchore.* See *Antidorcas euchore.*

MAMMALS—Continued.

ARTIODACTYLA—Continued.
  BOVIDAE—Continued.
    Antidorcas euchore:
      Taenia hydatigena.
    Oryx beisa:
      Taenia hydatigena.
    Oryx leucoryx:
      Taenia hydatigena.
    Ovis ammon:
      Echinococcus granulosus.
    Ovis argali:
      Echinococcus granulosus.
      Taenia hydatigena.
    Ovis aries:
      Echinococcus granulosus.
      Multiceps multiceps.
      Taenia hydatigena.
      Taenia ovis.
    Ovis mexicana:
      Taenia hydatigena.
    Ovis musimon:
      Taenia hydatigena.
    Rupicapra rupicapra:
      Taenia hydatigena.
    Rupicapra tragus. See *Rupicapra rupicapra.*
    Saiga tartarica:
      Taenia hydatigena.
    Tetraceros quadricornis:
      Echinococcus granulosus.
  SUIDAE.
    Phachochoerus aethiopicus:
      Taenia hydatigena.
    Phachochoerus africanus:
      Taenia hydatigena.
    Potamochoerus koiropotamus.
      Taenia hydatigena.
    Potamochoerus porcus. See *Potamochoerus koiropotamus.*
    Sus scrofa:
      Echinococcus granulosus.
      Taenia hydatigena.
    Sus scrofa domestica:
      Echinococcus granulosus.
      Taenia hydatigena.
  GIRAFFIDAE.
    Giraffa species:
      Echinococcus granulosus.
    Camelopardalis giraffa. See *Giraffa* species.

ARTIODACTYLA—Continued.
  CAMELIDAE.
    Camelus bactrianus:
      Echinococcus granulosus.
    Camelus dromedarius:
      Echinococcus granulosus.

PERISSODACTYLA.
  EQUIDAE.
    Equus asinus:
      Echinococcus granulosus.
    Equus caballus:
      Echinococcus granulosus.
      Multiceps multiceps.
    Equus zebra:
      Echinococcus granulosus.
  TAPIRIDAE.
    Tapirus americanus:
      Echinococcus granulosus.
    Tapirus indicus:
      Echinococcus granulosus.

PRIMATES.
  HOMINIDAE.
    Homo sapiens:
      Dipylidium caninum.
      Echinococcus granulosus.
      Multiceps multiceps.
  LASIOPYGIDAE.
    Simia cynomolgus. See *Pithecus* species.
    Simia sylvanus:
      Echinococcus granulosus.
      Taenia hydatigena.
    "*Simia faunus:*"
      Taenia hydatigena.
    Simia inuus. See *Simia sylvanus.*
    Simia silenus. See *Pithecus silenus.*
    Papio maimon:
      Taenia hydatigena.
    Pithecus species:
      Echinococcus granulosus.
      Taenia hydatigena.
    Pithecus silenus:
      Echinococcus granulosus.
    Macacus cynomolgus. See *Pithecus* species.
    Macacus inuus. See *Simia sylvanus.*

MAMMALS—Continued.

- PRIMATES—Continued.
  - LASIOPYGIDAE—Continued.
    - *Presbytis entellus:*
      - *Taenia hydatigena.*
    - *Semnopithecus entellus.* See *Presbytis entellus.*
    - *Semnopithecus cynosurus.* See *Lasiopyga cynosura.*
    - *Lasiopyga cynosura:*
      - *Taenia hydatigena.*
    - *Lasiopyga mona:*
      - *Taenia hydatigena.*
- PRIMATES—Continued.
  - LASIOPYGIDAE—Continued.
    - *Lasiopyga sabaeus:*
      - *Taenia hydatigena.*
    - *Cercopithecus mona.* See *Lasiopyga mona.*
    - *Cercopithecus sabaeus.* See *Lasiopyga sabaeus.*
    - *Inuus ecaudatus.* See *Simia sylvanus.*

REPTILES.

- SERPENTES.
  - COLUBRIDAE.
    - *Zamenis viridiflavus:*
      - *Dipylidium trinchesei.*

INSECTS.

- SIPHONAPTERA.
  - PULICIDAE.
    - *Pulex irritans:*
      - *Dipylidium caninum.*
    - *Ctenocephalus canis:*
      - *Dipylidium caninum.*
- MALLOPHAGA.
  - TRICHODECTIDAE.
    - *Trichodectes canis:*
      - *Dipylidium caninum.*

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A HERETOFORE UNDESCRIBED METEORIC STONE FROM KANSAS CITY, MISSOURI.[1]

By George P. Merrill,

Head Curator of Geology, United States National Museum.

The stone described below was first brought to the attention of the United States National Museum in October, 1917, by Mr. Edward Butts, curator of the Daniel B. Dyer Museum, of Kansas City, Missouri, who forwarded a small fragment for identification. Subsequent correspondence led to the forwarding of the entire stone to Washington for the purpose of making a cast and for description of the occurrence and its lithologic character. The history of the stone as given by Mr. Butts is as follows: It was found by a Mr. C. C. Frisby, who, in 1903, was working a stone quarry, now abandoned, at the corner of Twenty-fourth Street and Oakley Avenue, within the corporate limits of Kansas City. According to his statement, it lay some 6 feet below the surface, having penetrated 3½ feet of dirt and soil and 2½ feet of shaly limestone, coming to rest about 6 inches above the solid ledge. Although the meteoric nature of the find was suspected, no record seems to have been made of its finding, and inquiries made by Mr. Butts fail to bring to light any conclusive information on the subject. A Mr. Whiting, who had lived within 100 feet of the spot for the past 25 years, had no knowledge of a fall in the vicinity, nor had a Mr. King, who had lived for 33 years about a fourth of a mile away. From its general appearance one can only surmise that it belongs to an old and unrecorded fall.

It may be well to note, however, that in the Transactions of the St. Louis Academy of Science for December, 1875, Prof. J. C. Broadhead described the flight of a meteorite over eastern Nebraska and northwest Missouri, the stone traveling in a general southeasterly direction and becoming disrupted with the usual explosive accompaniments in the vicinity of St. Joseph, some 50 miles north of Kansas City, whence it passed onward and was lost to sight. As the directions mentioned would carry the main mass to the east of Kansas City, and as, moreover, the stone here being described must have traveled for a very considerable distance as a nearly complete individual (it is plainly not a fragment), it seems more than doubtful if there is any connection between the phenomena described by Broadhead and this particular fall.

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[1] Museum Catalogue, No. 583.

On casual inspection the stone resembles an ordinary decomposed bowlder of basic igneous rock, much oxidized, cracked, and somewhat exfoliated (see pls. 1 and 2). Closer inspection, however, shows still remaining traces here and there of fusion crusts, which gathered in thicker blebs and drops on what was plainly the rear of the stone in its flight through the atmosphere. These are distinctly shown in the lower portion of plate 2. A polished surface of a fragment removed from the already broken portion at the upper left of figure 2 shows a texture as fine, firm, and hard as that of the stone of Estacado, Texas. The color is dark-brown gray and the indistinct chondrules much darker. Thin sections under the microscope show it to be a crystalline spherulitic chondrite, consisting essentially of olivine and enstatite with the usual sprinkling of metal and sulphide, the metallic particles being small and quite inconspicuous excepting when a polished surface is viewed in reflected light. Occasional small, colorless particles showing an indistinct twin banding may be feldspathic. Oxidation has proceeded too far in the fragment available for study to make a chemical analysis seem worth the while. It was hoped the holders of the stone would permit its being cut to sufficient depth to yield less oxidized material. This, however, they are averse to doing.

This stone when received weighed 34,500 grams. This, allowing 1,500 grams for the fragments lost through breaking and exfoliation, gives an approximate original weight of 36 kilograms for the entire mass. The dimensions are 36.5 cm. by 33 cm. by 20.5 cm. It will be known as the Kansas City meteorite, the fourth *stone* found within the limits of the state.[1]

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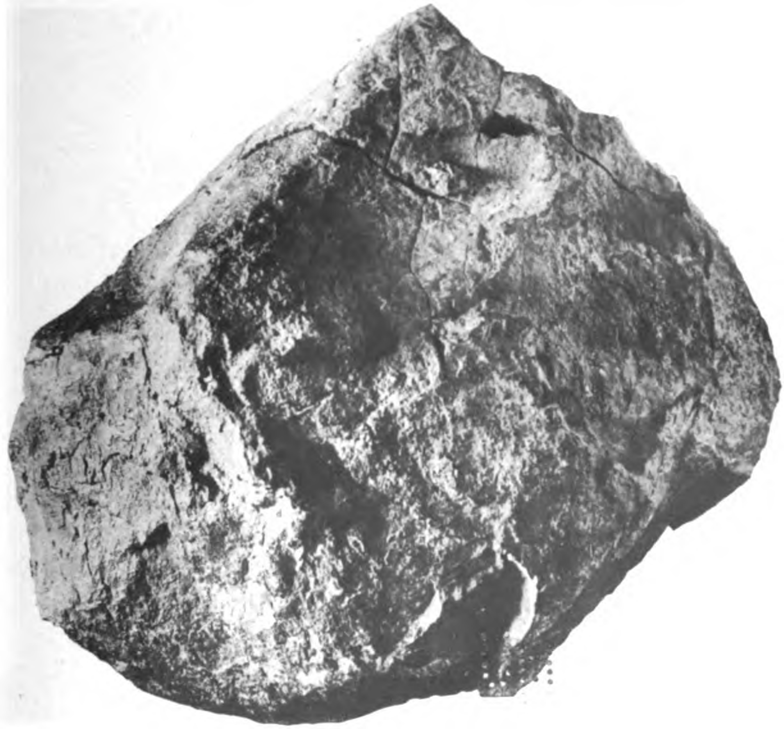
[1] I find the following in the American Journal of Science for 1876, "On the fall of a Meteorite in Kansas City, Missouri, June, 1876, by John D. Parker (letter to Editors dated Kansas City, Mo., Aug. 2, 1876). On June 25, 1876, between the hours of 9 and 10 in the morning, a small meteorite fell upon the tin roof of Mr. Isaac Whittaker's business house, No. 556 Main Street, Kansas City, Mo. The meteorite came down with sufficient force to cut a hole in the tin roof on the front part of the house near an open window, but not passing entirely through the tin, it bounded back a few feet and lay on the roof. Mrs. Baker, who occupies rooms in the front part of the house in the second story, and Mrs. Whittaker, were standing near the window when the meteorite fell, and heard the sharp concussion when it struck the roof. Mrs. Baker immediately picked up the meteorite as it lay near her on the roof, but dropped it again, finding it too hot to retain it in her hand. The meteorite is a plano-convex specimen, about 1⅜ inches in diameter and about ⅛ of an inch in thickness. The outside or convex surface possesses the usual crusted appearance, while the inside or plane surface differs from ordinary meteorites in possessing the appearance of sulphuret of iron, subjected to some degree of heat, instead of nickeliferous iron. One might easily infer that the meteorite was shaled off from a large bolide that passed over the city at that time. As it fell in the city, I have named it the Kansas City Meteorite. It has not been subjected to chemical analysis."

As nothing further has been learned regarding the above, and as, moreover, the meteoric nature of the object would seem to be at least doubtful, the name given it by Mr. Parker is not to be found in existing literature and may well be preempted, to use a mining term, in favor of the present fall.



KANSAS CITY METEORIC STONE (FRONT VIEW).

FOR EXPLANATION OF PLATE SEE PAGE 96.

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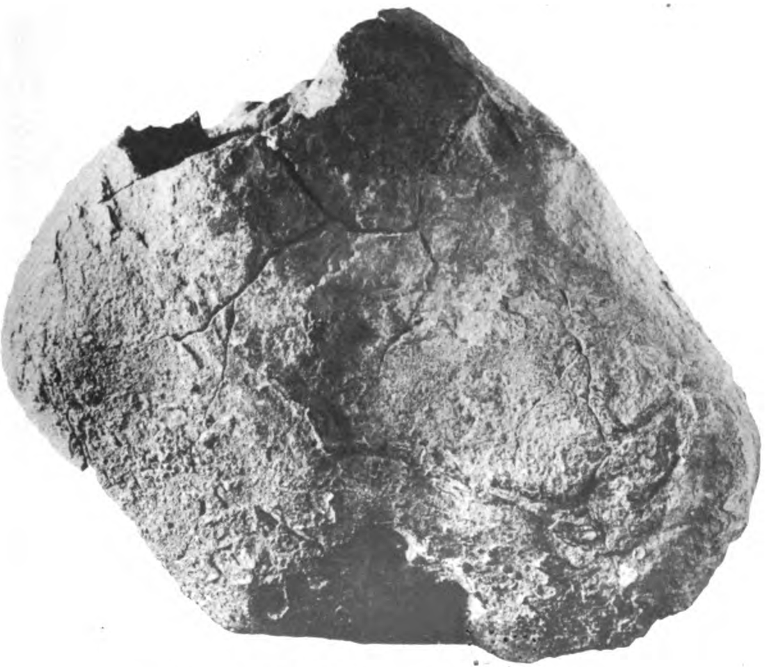

KANSAS CITY METEORIC STONE (REAR VIEW).

FOR EXPLANATION OF PLATE SEE PAGE 96.

A NEW RESTORATION OF TRICERATOPS, WITH NOTES ON THE OSTEOLOGY OF THE GENUS.

By Charles W. Gilmore,

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INTRODUCTION.

The life appearance of *Triceratops* has been depicted by numerous paintings and by at least three model restorations. During the years that have passed since most of these restorations were prepared, the discovery of many new specimens and especially of well-preserved skin impressions has added greatly to our knowledge of the probable life appearance of the horned dinosaurs. The accompanying photographic reproduction, made from a recently prepared model, aims to embody all of the evidence of recent discoveries and also to express my conception of this animal in the flesh. (See pl. 3.)

The model is based upon the mounted skeleton[1] in the United States National Museum made to one-fourteenth the linear dimensions of the original skeleton. It will be noticed that the head is quite different from the skull on the skeleton and in explanation it should be said that the skull and lower jaws on the mounted specimen pertain to a different individual than the axial and appendicular portions, but that with the latter was found a single large horn-core which was identified by the late Mr. J. B. Hatcher as resembling the horn-cores of *Triceratops elatus* Marsh, and on account of that resemblance, I have selected the skull of that species as the basis for the head in the present model.

The nonimbricating, scalelike texture of the skin as represented in the model is based, with modifications, upon the recently discovered Ceratopsian remains in the collections of the Canadian Geological Survey, at Ottawa, with which well-preserved skin impressions were found.[2] Although these skin impressions pertain to one of the more primitive Ceratopsians it is quite reasonable to expect that all of the horned dinosaurs had a scaled integument, though the pattern of the scales may have varied considerably in the different genera, as they are known to do in the various Trachodont genera.

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[1] Gilmore, Charles W., Proc. U. S. Nat. Mus., vol. 29, 1905, pls. 1 and 2, pp. 433–435.

[2] Lambe, L. M., Ottawa Naturalist, vol. 27, 1914, p. 132, pl. 14.

Since this model was prepared in 1915, a second Ceratopsian specimen (type of *Monoclonius cutleri* Brown) having impressions of the skin preserved has been discovered. According to Brown[1] the polygonal scales extended down over the belly, instead of the small rounded scales here represented as covering those parts in the model, but, of course, we can not be certain that the same arrangement of the scales prevailed in the genus *Triceratops*.

One other noticable departure from earlier restorations is in freeing the femoral part of the hind limb from the flank, thus adopting a reptilian form of limb, rather than the mammalian form previously used.

Future discoveries may show many features of the present restoration to be incorrect, but at the least it graphically portrays some of the discoveries made during the past 10 years, in our knowledge of the probable life appearance of these huge-headed reptiles now so long extinct.

NOTES ON THE OSTEOLOGY OF TRICERATOPS.

The entire collection of vertebrate fossils, in the United States National Museum, from the Lance formation of Wyoming has now been prepared for study and exhibition. This collection, made by the late J. B. Hatcher and his associates during the years 1889 to 1891, formed a part of what is known as the "Marsh collection" transferred to the Museum by the United States Geological Survey.

In the course of this work, specimens were found which contribute to a better understanding of the osteological structure of certain members of the Ceratopsia, and especially important was the uncovering of additional bones pertaining to the type-specimens on which *Triceratops obtusus* Marsh and *Triceratops calicornis* Marsh were founded.

Notes relating to the more important of these specimens are given in the following pages.

THE TYPE-SPECIMEN OF TRICERATOPS OBTUSUS MARSH.

The type of this species as enumerated by Hatcher[2] in 1907, consisted of "a pair of mandibular dentaries and the anterior portion of the nasals, a left maxillary, a squamosal parts of a pterygoid, and a vertebra." The finding of nearly the entire remaining parts of the skull (see pl. 4) is a welcome addition to the above material, and it now places the type on an adequate foundation for comparison with the other and better known species.

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[1] Bull. Amer. Mus. Nat. Hist., vol. 37, art. X, 1917, p. 299, pl. 18.

[2] The Ceratopsia, Monograph 49, U. S. Geological Survey, 1907, p. 140.

Although somewhat distorted latterly by pressure the skull is essentially complete, lacking only the rostral, premaxillary bones, and the median portion of the frill or demosupraoccipital.

That the skull belongs to the same individual as the type is shown by the similarity of the labels accompanying both, by the unusual bright yellowish color of the bones and also by the finding of fragments with the skull that fitted the dentaries, and fragments with the nasals and dentaries that were fitted to the skull.

The original description by Professor Marsh and the more recent description by Hatcher are given in their entirety below:

Professor Marsh described this species as follows:

> A second new species, which may be called *Triceratops obtusus*, is represented by a large skull belonging to the same genus. The nasal horn core of this skull is very short and obtuse and so well preserved that it indicates the normal form and size. The entire length of this horn core is only 1 inch. Its summit is 3½ inches behind the premaxillary suture. The width of the nasals beneath the horn core is 5½ inches. The length of the squamosal from the quadrate groove to the posterior end is about 36 inches and its greatest width is 19 inches.
>
> These two skulls [types of *T. calicornis* and *T. obtusus*] were both found by J. B. Hatcher in the Ceratops beds of Converse [Niobrara] County, Wyo.

Hatcher redescribes the specimens in the following:

> The type (No. 4720, U. S. National Museum) of the present species consists of a pair of mandibular dentaries and the anterior portion of the nasals, a left maxillary, a squamosal, parts of pterygoid, and a vertebra. The specific name was suggested by the nasal horn core. The nasals, as shown in the accompanying figures, are extremely broad, and the nasal horn core is reduced to a broad, rounded, and rugose prominence, marked with a number of deep vascular grooves.
>
> The dentary is exceptionally deep and the teeth are unusually large. Below the base of the coronoid process on either dentary the external surface of the bone presents a very sharp ridge that extends continuously throughout about one-third of its length. The posterior portion of the alveolar region of the left dentary bears evidence of having been affected by disease and presents extensive malformations. The mandibular fossa extends rather farther forward than is common in other species of the Ceratopsia. The dentary is exceptionally massive and the teeth are very large. There are a number of foramina on the external surface of the dentary, as shown in the accompanying figure.
>
> Notwithstanding the scanty and fragmentary material upon which the present species is based, it would seem to be a valid one, as indicated alike by the characters of the dentary, the teeth, the nasal horn core, and that part of the nasals still preserved.
>
> The type of the present species was found in Converse [Niobrara] County, Wyo., about 1 mile east of Lance Creek and 2 miles southeast of the U-L ranch. The horizon would be about the middle of Laramie [Lance], as those deposits are represented in this region. The locality is shown at +9, Pl. LI.

> ***Principal Measurements of the Type-Specimen.***
>
> | | mm. |
> |---|---|
> | Greatest length of dentary | 670 |
> | Greatest depth of dentary | 229 |
> | Length of dental series | 535 |
> | Breadth of nasals at base of horn core | 140 |
> | Distance from top of nasal horn core to inferior surface of nasals | 75 |
>
> I have been unable to find in the collections of the U. S. National Museum the squamosal mentioned by Marsh as pertaining to the type, and can say nothing concerning the form of this important element. The other portions of the skeleton preserved show no peculiarities worthy of note.

The missing squamosal mentioned by Hatcher was found in one of the recently opened boxes. The left squamosal, lacking the posterior end (see pl. 4), was attached to the skull. Although Hatcher collected this specimen, the presence of nearly the entire skull had obviously entirely escaped his memory, as no allusion is made to it in any of his writings. The characters pointed out by Hatcher for distinguishing this species are for the most part of a trivial nature and little dependence can be placed on them as representing constant specific differences. The peculiarities found in the dentaries may be attributed in a great degree to the severe crushing which these bones have undergone, in addition to the malformations in the left element to which Hatcher calls attention. A comparison of the dentaries with others in the collection of the United States National Museum fails to disclose any great degree of difference in the forward extension of the mandibular fossa, its apparent extension being due to the absence of the overlying splenial and to deformation of the bone by vertical pressure. The width of the nasals also appears to have been exaggerated by crushing. Of the specific characters pointed out by Hatcher, the reduced nasal horn core alone is probably valid, though it may be only a sex character. The supraorbital horns as compared with the types of *T. calicornis* Marsh and *T. elatus* Marsh are somewhat shorter and lack the great forward curvature. They are not quite as stocky as those of *T. brevicornus*, which they resemble most nearly in a lateral view.

After a careful comparison of this additional material of *T. obtusus* with the several types in the United States National Museum collections, and with the figures and descriptions of other species of the genus preserved elsewhere, I am unable to detect characters that would satisfactorily distinguish this species.

In the present accepted classification of the Ceratopsia, and especially of the species of the genus *Triceratops*, great importance is attached to the development of the nasal and supraorbital horn cores, and the peripheral outgrowths of the frill. It is not yet clear how much dependence can be placed on the differences found in these horns, or their almost complete absence as in *T. obtusus*. There is great variation, as might well be expected in such highly specialized outgrowths, and the differences in sex, and stage of growth present other features that have also to be considered before a satisfactory conclusion can be reached as to what characters constitute valid specific differences. In fact, the whole group needs restudying. Such a revision assisted by the considerable number of new specimens discovered since the writing of the Ceratopsia monograph in 1907 may enable an investigator to straighten out this confusion. At the present time it appears quite certain that the number of described species is too great by a considerable number.

THE TYPE-SPECIMEN OF TRICERATOPS CALICORNIS MARSH.

At the time of writing the Monograph on the Ceratopsia, Hatcher[1] and Lull mentioned their inability to locate in the collections of the United States National Museum the lower jaws pertaining to the type-specimen of *Triceratops calicornis* Marsh, No. 4928, U. S. N. M. Upon opening a large box, listed as containing the skull of another individual in it was found the long misplaced dentaries. These are in an excellent state of preservation. In the same block of sandstone with the lower jaws was a posterior cervical vertebra and portions of several thoracic ribs.

The vertebra is from the posterior part of the neck and represents the seventh of the series counting backward from the skull, or it belongs behind the first of the series as illustrated in figure 2, plate 40, of the monograph cited above. Figure 2, Plate 5, shows this vertebra inserted in its proper position in the vertebral series. That this is the correct position of this element in the vertebral column is clearly shown by the shape and length of the transverse processes and also by the perfect articulation of the zygapophyses.

The dentaries except for their great size are similar to those of other described species, and the few minor differences observed do not add anything to the diagnosis of the species.

The principal measurements of the dentaries are:

	mm.
Greatest length	645
Greatest depth	170
Length of dental series	480

In the left ramus there are 38 rows of teeth in the dental magazine.

The type-specimen now completely assembled consists of the following parts:

Skull, lacking some parts of the frill, lower jaws, 2 cervical vertebrae (portions of atlas and other cervicals), 10 dorsal vertebrae (portions of other dorsals), 5 cervical ribs, 2 thoracic ribs (many parts of others), both pubes, both ilia (poorly preserved), sacrum (poorly preserved), and many ossified tendons.

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[1] Monograph 49. U. S. Geological Survey, 1907, p. 139.

CERATOPSIAN VERTEBRAE.

In plate 5, figure 1, is shown an articulated series of eight posterior dorsal vertebræ (No. 8091, U.S.N.M.), collected by Messrs. J. B. Hatcher and A. D. Sullins in 1891 on Schneider Creek, Niobrara County, Wyoming. These vertebræ are notable for their fine state of preservation and that they are from that part of the column of which but little is known at the present time. This series pertains to a member of the genus *Triceratops*, but the species has not yet been determined.

A DISEASED CERATOPSIAN SCAPULA.

In plate 6, figures 1 and 2, is shown two views of a Ceratopsian scapula, of the right side belonging to the genus *Triceratops*, which is of interest on account of the presence on the internal side, of an otherwise normal bone, of a large bony hornlike growth. Fossil bones are often found, and especially of the horned dinosaurs, showing fractures that have healed in life (see pl. 9) usually with a considerable enlargement at the point of fracture, but in the present specimen there is no evidence of the bone having been fractured, though this horn-like projection is doubtless an exostosial growth due to pathologic conditions. That it must have been very uncomfortable to the animal, and a serious handicap to the movement of the shoulder blade, is readily apparent.

The scapula (No. 8013, U.S.N.M.) was collected by the late J. B. Hatcher in 1891 from the Lance formation in Niobrara County, Wyoming.

RELATIONSHIPS OF CERTAIN CRANIAL ELEMENTS IN THE SKULL.

During the past few years several papers have been written in which the homologies of the bones of the Ceratopsian skull and brain case have been discussed in considerable detail. While each author has contributed to a better understanding of these elements and their relationships there is still a lack of unanimity of opinion regarding some of them. Certain modifications have led to such a rearrangement of the cranial elements that until correctly interpreted are as confusing as they are unusual. The coossification early in life of most of the bones, is another feature that still further adds to the difficulty of determining their true relationships. A restudy of specimens in the United States National Museum in conjunction with wo *Triceratops* skulls recently prepared further elucidate the homologies of these bones and also furnish corroborative evidence in support of the conclusions reached by me in an earlier study of a juvenile skull of *Brachyceratops*[1] *montanensis*.

In plate 8 is shown a fragmentary skull (Cat. No. 5740, U.S.N.M.) in longitudinal section. It is known by the field designation as Sk. 27, and was collected by Messrs. J. B. Hatcher and A. D. Sullins, in 1891 on Doegie Creek,[2] Niobrara County (formerly Converse County),

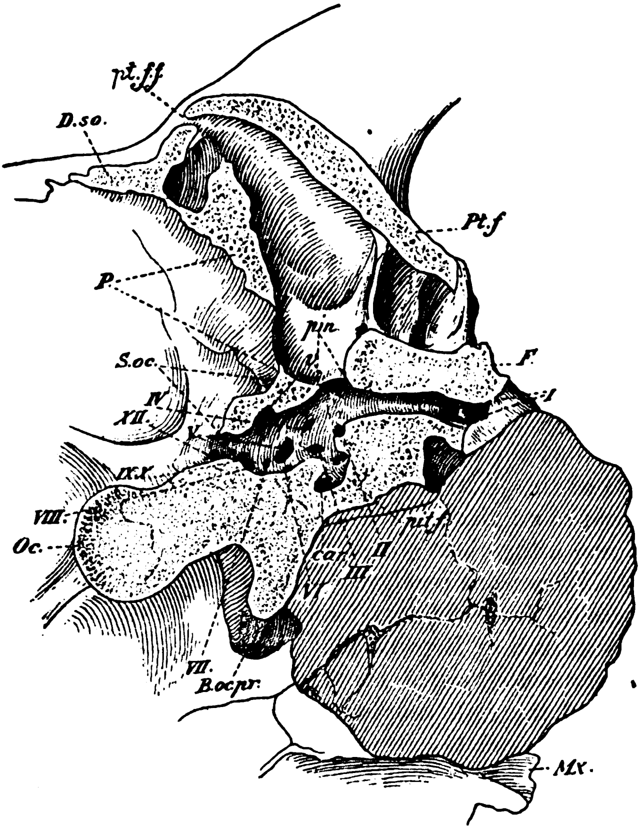

FIG. 1.—LONGITUDINAL SECTION OF SKULL SHOWING BRAIN CAVITY OF TRICERATOPS, FROM NO. 5740, U.S.N.M., ABOUT ONE-EIGHTH NATURAL SIZE. B. OC. PR., BASIOCCIPITAL PROCESS; CAR., FORAMEN FOR LEFT CAROTID ARTERY; D. SO., ANTERIOR END OF DERMOSUPRAOCCIPITAL; F., POSTERIOR PORTION OF FRONTAL; MX., MAXILLARY; OC., OCCIPITAL CONDYLE; P., PARIETAL, IT ALSO EXTENDS FORWARD AROUND THE PINEAL FORAMEN TO MEET THE THICKENED POSTERIOR END OF THE FRONTAL; PIN., PINEAL FORAMEN; PIT. F., PITUITARY FOSSA; PT. F., POSTFRONTAL; PT. FF., POSTFRONTAL FONTANELLE; S. OC., SUPRAOCCIPITAL; V., FORAMINA FOR EXIT OF SUPPOSED VEINS; I, II, III, IV, V, VI, VII, VIII, IX, X, XII, FORAMINA FOR EXIT OF CEPHALIC NERVES OF CORRESPONDING NUMBERS.

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[1] Professional Paper 103, U. S. Geol. Survey, 1915.

[2] In plate 49 of Monograph 49, U. S. Geological Survey, 1907, Sk. 27, is indicated on the map as having been found on Bull Creek, but in figure 53 (p. 207) of the Dinosaurs of North America this same stream is designated Doegie Creek, which agrees with the original label found with the specimen. The former is probably an error made in transscribing the legends on the map.

Wyoming. On account of the absence of all the essential external portions such as the horn-cores, nasals, premaxillaries, and most of the squamosals, I am unable to determine the species to which this specimen belongs. It serves, however, to graphically illustrate the internal structure of the Ceratopsian skull, and especially the relatively small size and position of the brain cavity, and the large overlying sinuses.

A study of this sectional skull in conjunction with the posterior portion of the cranium of a second individual (Cat. No. 6679, U.S.N.M.; see Plate 7.) *Triceratops* species, and the disarticulated skull of *Brachyceratops montanensis* (Cat. No. 7951, see fig. 4) enables me to verify the work of other authors and in some instances to point out where they were in error. Commencing with the frill I think all authorities are agreed that the lateral bones are the squamosals. It is the median part of the frill that has been the subject of much discussion and a variety of interpretations. Marsh first identified it as the fused parietals, and he has been followed by most writers on the subject. Hay[1] showed that this identification could not be accepted and suggested that it might represent the fused supratemporals or possibly the coalesced nuchal bones. Huene[2] identified the anterior end of this central portion as parietal and the posterior end as a dermosupraoccipital, but it has been pointed out that this conclusion is not altogether acceptable. Gilmore[3] in describing the skull of *Brachyceratops* reached the conclusion that the parietal was entirely excluded from the dorsal surface of the skull in that genus—a conclusion verified by Brown[4] in a later study of other Ceratopsiam skulls. In the article cited above Brown also concludes that the median part of the frill represents the "fused postfrontals." The study of the disarticulated *Brachyceratops* skull which has the postfrontal bones entire (see fig. 4), shows conclusively that they do not extend backward to form any part of the crest. In fact a comparison of the top of the *Brachyceratops* skull with a *Monoclonius* skull, figured by Brown[5] shows a transverse line between the supratemporal fossae, separating their posterior ends from the frill portion as in *Brychyceratops* although it is not there recognized as a suture. That a suture does exist at this point is abundantly shown by several skulls and numerous separate frills. That the conclusion reached by both Gilmore and Brown that the parietal does not show on the dorsal surface of the skull is further substantiated by specimens Nos. 5740 and 6679, particularly the latter, which shows the parietal as extending upward and backward as a thin sheet of bone underlapping the forward part of the dermosupraoccipital to which it is closely applied, by squamous suture, thinning out to a thin edge along the line indicated in *s*. plate 7. From a posterior view Huene depicts the lateral extent of the parietal quite clearly in figure 2 of the paper cited above, and Brown also shows its more limited develpment in the genus *Monoclonius*. (See fig. 2, Bull. Amer. Nat. Hist., vol. 33, 1914, p. 555.)

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[1] Proc. U. S. Nat. Mus., vol. 36, 1908, pp. 95–108.

[2] Neues Jahrbuch, vol. 11, 1911, pp. 146–162.

[3] Smiths. Misc. Coll., vol. 63, No. 3, 1914, p. 7.

[4] Bull. Amer. Mus. Nat. Hist., vol. 33, October, 1914, p. 543.

[5] Idem, vol. 34, October, 1914, pp. 549–558, fig. 1.

All writers are agreed as to the position of the postfrontals as being immediately in front of the dermosupraoccipital (called parietal, postfrontals, supratemporals, etc.) bone, but there is much disagreement as to the extent of these elements. Marsh, Hatcher, Lull, Brown, and Lambe considered the postfrontal as including nearly all of that portion of the skull between, and including the horn cores and an area on the lateral surface extending down and back of the orbit to its inferior level. Huene correctly recognized a portion of the lateral area posterior to the orbit as being the postorbital and so it stood until the discovery of the *Brachyceratops* skull which demonstrates conclusively that the postorbital in that genus includes the horn above the eye and that the lateral extension of the post frontals is not external but internal to the supraorbital horn cores, as shown

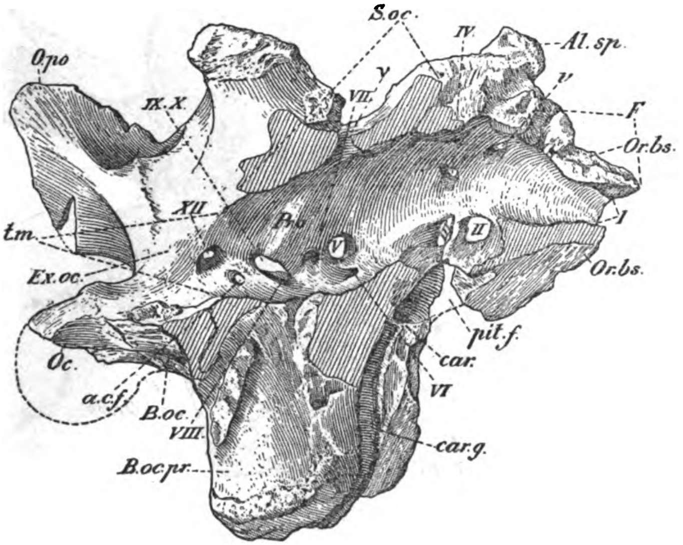

Fig. 2.—Longitudinal section of brain case of Triceratops serratus Marsh No. 2416, U.S.N.M. About one-third natural size. A. c. f., anterior condyloid foramen; Al. sp., alisphenoid; B. oc., basioccipital; B. oc. pr., basioccipital process; Car., foramen for left carotid artery entering pituitary fossa; Car. g., groove for right carotid artery; Ex oc., exoccipital; F., extent of the articulation of the frontal with the underlying orbitosphenoids; Oc., occipital condyle; Or. bs., orbitosphenoid; O. po., paraoccipital process; Pit. f., pituitary fossa; Pro., prootic; S. oc., supraoccipital; T. m., foramen magnum; v., foramina for exit of supposed veins; I, II, III, IV, V, VI, VII, VIII, IX, X, XII, foramina for exit of corresponding cephalic nerves.

in figure 4. I can hardly believe, in the light of the *Brachyceratops* skull, that the postorbital bone has been so reduced in size in *Triceratops* as indicated by Huene. In a recent paper by Lambe[1] the small bones interposed between the prefrontals and identified as the frontals represents without question the forward ends of the postfrontals.

The frontals, as pointed out by Huene,[2] do not appear on the dorsal surface, but are excluded from that view by the overlying prefrontals (the lachrymals of Huene). Figure 6 shows a longitudinal section of the skull of *Triceratops flabellatus* Marsh after Lull where the frontal = prefrontal + postfrontal) is indicated as having an inferior branch directed downward and backward from the nasals to the anterior part of the brain case. This lower branch represents the true frontal as is clearly shown by the juvenile *Brachyceratops*[3] skull in which the overlying pre- and postfrontals exist as distinct elements. A study of the sectioned skull (No. 5740, U.S.N.M.) plate 8 and text figure 1 now enables me to definitely determine for the first time the posterior extent of the frontals, as being the thickened bone immediately overlying the olfactory lobe of the brain,

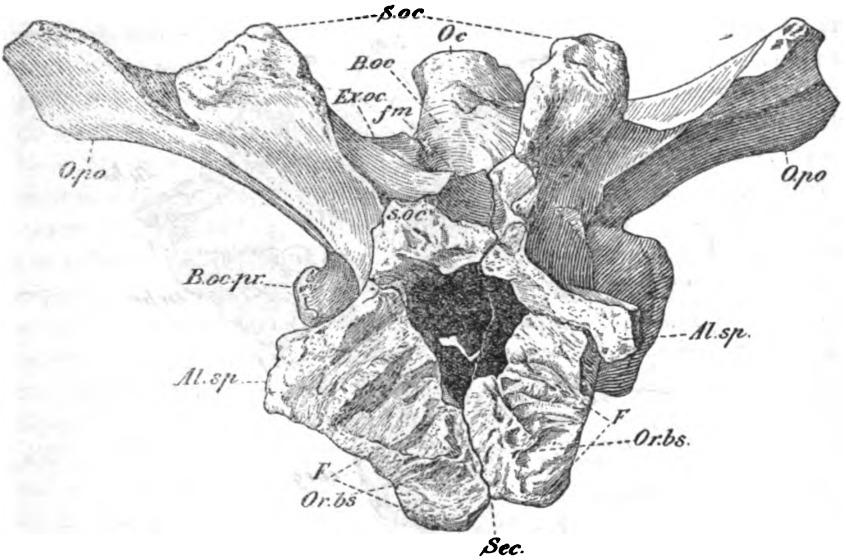

FIG. 3.—SUPERIOR VIEW OF BRAIN CASE OF TRICERATOPS SERRATUS MARSH, NO. 2416, U.S.N.M. ABOUT ONE-THIRD NATURAL SIZE. AL. SP., ALISPHENOID; B. OC., BASIOCCIPITAL; B. OC. PR., BASIOCCIPITAL PROCESS; EX OC., EXOCCIPITAL; F., SHOWING EXTENT OF THE ARTICULATION OF THE FRONTAL WITH THE UNDERLYING ORBITOSPHENOIDS; FM., FORAMEN MAGNUM; OC., OCCIPITAL CONDYLE; O. PO., PARAOCCIPITAL PROCESSES; OR. BS., ORBITOSPHENOIDS; SEC., LINE INDICATING POINT OF SEPARATION OF TWO HALVES OF BRAIN CASE, OF WHICH A SECTION IS SHOWN IN FIG. 2; S. OC., SUPRAOCCIPITAL.

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[1] Museum Bull. No. 12 Canada Department of Mines, pl. 9, figs. 1, 2, 1915.

[2] Neues Jahrbuch, vol. 11, 1912, fig. 1.

[3] See Prof. Paper 103, U. S. Geol. Surv., 1917, p. 10, fig. 6.

see *F*, figure 1, and extending back to the pineal foramen, see *pin*, figure 1. In the great thickening of the bone and its relationship to the brain and underlying structure, it closely resembles the frontal of *Diplodocus longus* Marsh as shown in figure 5, *Fr*. In specimen No. 5740, U.S.N.M., the sutures are almost entirely obliterated, but in a second brain case of *Triceratops serratus* Marsh (No. 2416, U.S.N.M., see figs. 2 and 3) the olfactory lobe is entirely inclosed by what Hay regarded, and I believe correctly, to be the united orbitosphenoids. Such a condition is unusual, for in no other reptile living or extinct have I observed these bones thus inclosing this part of the brain. Usually the frontal forms the median upper boundary and I presume such a condition will be found to prevail

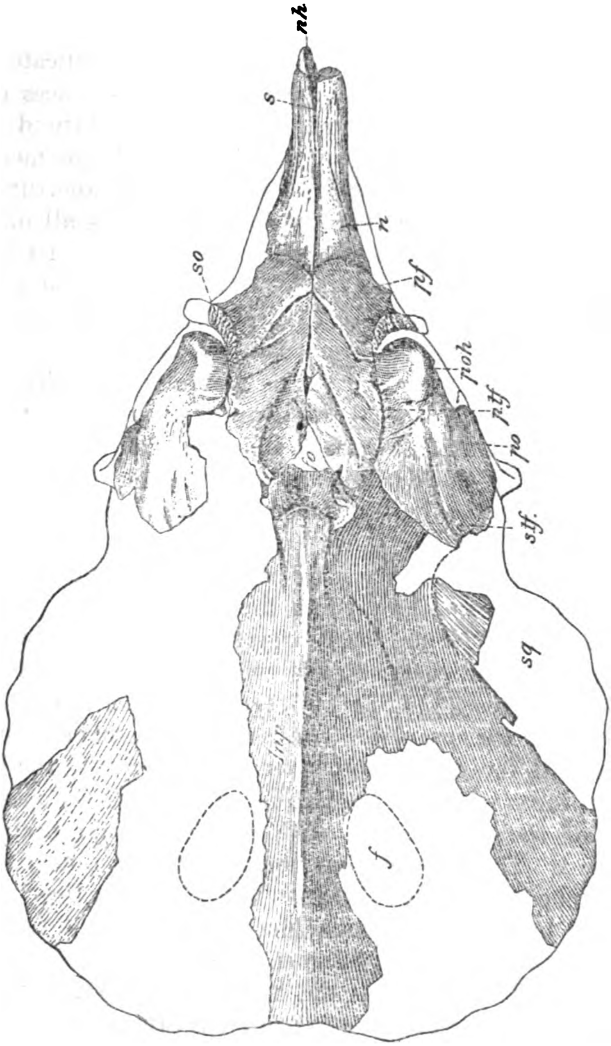

FIG. 4.—SKULL OF BRACHYCERATOPS MONTANENSIS GILMORE. TYPE NO. 7951, U.S.N.M. ONE-THIRD NATURAL SIZE. SUPERIOR VIEW; F., FENESTRA IN FRILL; FO., POSTFRONTAL FONTANELLE; IN. P., DERMOSUPRAOCCIPITAL; N., NASAL; NH., NASAL HORN CORE; PF., PREFRONTAL; PO., POSTORBITAL; POH., POSTORBITAL HORN CORE; PTF., POSTFRONTAL; S., SUTURE SEPARATING TWO HALVES OF NASAL HORN CORE; SO., SUTURAL BORDER FOR MISSING SUPRAORBITAL BONE; SQ., SQUAMOSAL; ST. F., SUPRATEMPORAL FOSSA. (AFTER GILMORE.)

in most Ceratopsian skulls. In fact, in specimen No. 5740 U.S.N.M., a longitudinal ridge, that may represent a coalesced suture, runs along the inside of the wall of the brain case for the olfactory lobe and if correctly interpreted shows that the frontal did contribute to the upper boundary of this part of the brain. By comparing specimens Nos. 5740 and 2416 it was possible to determine the exact extent of the articulation between the frontals and the underlying sutural surfaces of the orbitosphenoids in No. 2416, as indicated in figure 3, *F*. It will also be noted that these sutural surfaces continue backward over the superior surfaces of the alisphenoid and supraoccipital bones, thus entirely surrounding the large median opening above the cerebrum lobe of the brain. This aperture as shown in figure 3 is larger than it would be normally as all of the borders present broken edges. The question now arises, what bone articulated with these sutural surfaces? After a study of many reptilian skulls both recent and extinct it is found that the parietal is the only bone that fills all requirements. As in other reptilian skulls it here articulates anteriorly with the frontals; ventrally with the supraoccipital, alisphenoids, and in all probability also with the prootic. Furthermore, specimen No. 5740, U.S.N.M., shows that immediately behind the thickened rounded posterior end of the frontal is a well-defined median foramen leading from the brain case into the large air chamber above (see *pin.* fig. 1), and represents without question the interparietal or pineal foramen. The position of this foramen on the median line and near the sutural union of the parietal and frontal, and largely if not entirely within the former bone, is in entire agreement with the location of this foramen, in *Diplodocus* see *f. pin.*, figure 5, the living *Hatteria*, and in the Ichthyosauria and Plesiosauria. The large air chamber or sinus into which the pineal foramen opens, extends upward into the base of the large horn cores with an external outlet through an opening at the junction of the postfrontals with the dermosupraoccipital see *pt. f. f.* figure 1. This opening has been designated pineal foramen by Marsh; "the postfrontal foramen," by Hatcher; the "postfrontal fontanelle," by Lull and Lambe; the "supratemporal fossae," by Hay; and the "pseudopineal foramen," by Huene. The term "postfrontal fontanelle" is perhaps the more appropriate designation for this opening rather than "postfrontal foramen" the use of which was advocated in my study of the *Brachyceratops*[1] skull for the reason that it represents an opening not yet roofed over by bone, or, in other words, the coalescence of the postfrontals with one another and with the dermosupraoccipitals which had begun in the earliest known Ceratopsians had not been perfected, except in old individuals belonging to the last we know of the race.

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[1] Prof. Paper 103, U. S. Geol. Survey, 1914, p. 18

Specimen No. 5740 shows that portion of the parietal around the pineal foramen and extending upward above the supraoccipital to have been very thin on the median line. Whether it becomes heavier laterally can not be determined, but higher up it widens perceptibly provided all of the bone is parietal, but it again thins out into a wide sheet of bone that underlaps the dermosupraoccipital as shown in plate 7, *P.* as has been previously described.

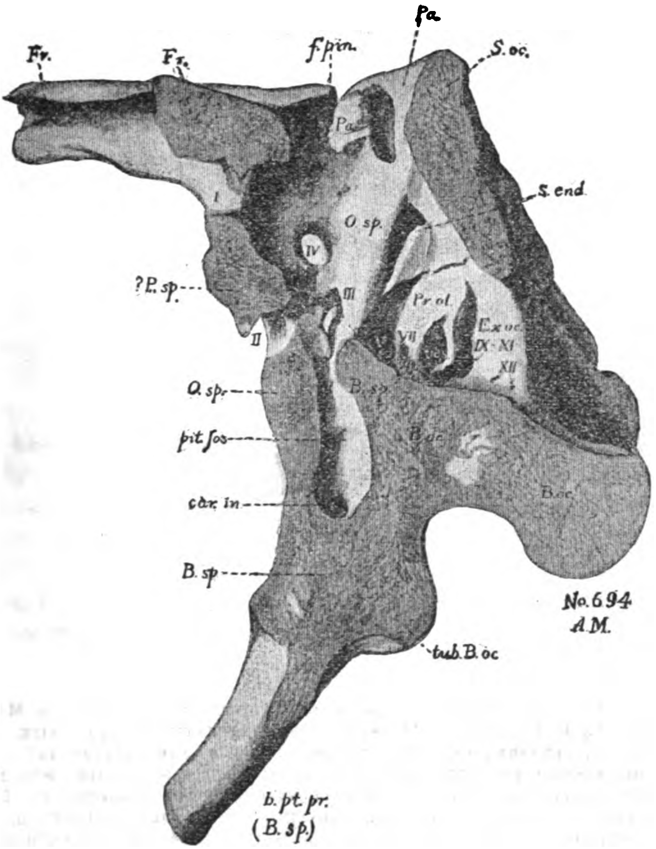

Fig. 5.—Longitudinal section of skull of Diplodocus longus Marsh, No. 694, Amer. Mus. Nat. History. One-half natural size. B. oc., basioccipital; B. pt. pr., basipterygoid processes; B. sp., basisphenoid; car. in., foramen for right carotid artery; Ex. oc. exoccipital; f. pin., pinal foramen; Fr., frontal; O. sp., orbitosphenoid; Pa., parietal; pit. fos., pituitary fossa; Pr. ot., prootic; ?P. sp., presphenoid; s. end., saccus endolymphaticus; S. oc., supraoccipital; tub. B. oc., basioccipital tuberosity; I, II, III, IV, V, VI, VII, IX, XI, XII, foramina for exit of corresponding cephalic nerves. (After Osborn.)

In figure 2 *S. oc.*, the supraoccipital is indicated as extending from the top of the foramen magnum to the sutural surface above the foramen for the exit of the IV nerve. Hay in figuring this same specimen[1] regarded only the lower or posterior half as supraoccipital, the upper or anterior half the parietal. Their junction being indicated by the foramen at the extremity of the left cerebellar process.[1] Brown in discussing the brain case of *Anchiceratops* and of a Trachodont dinosaur[2] regards this same point as being the position of the suture between these two bones. In none of the specimens discussed above can a suture be detected at this point, and the presence of a sutural surface on the upper end of the bone here called supraoccipital (see *s. oc.*, fig. 3), seems to me to clearly indicate the forward extent of this bone to be as shown in figure 2, *S. oc.*

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[1] See Proc. U. S. National Museum, vol. 36, 1909, pl. 2, fig. 1.

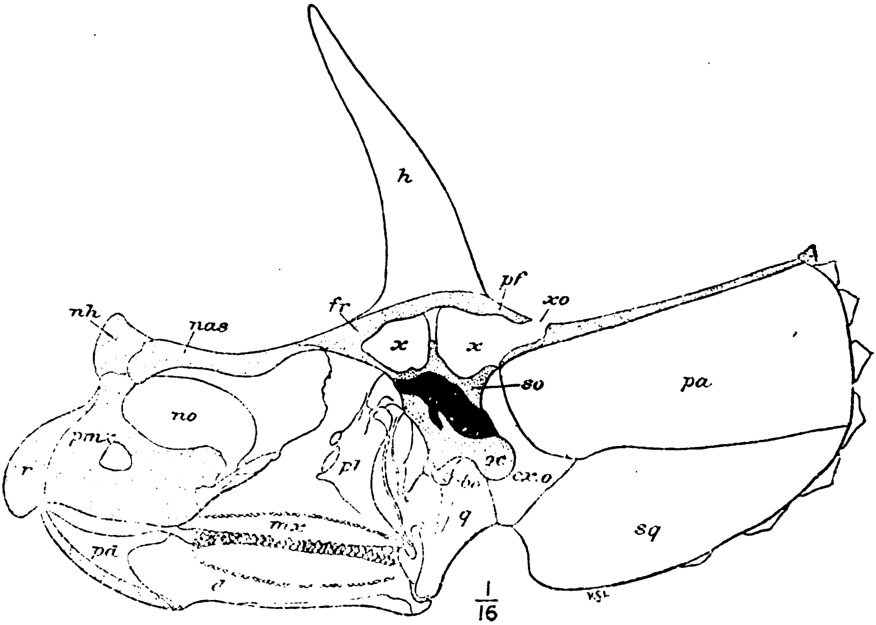

FIG. 6.—LONGITUDINAL SECTION OF SKULL OF TRICERATOPS FLABELLATUS MARSH, FROM NO. 1821, YALE UNIVERSITY MUSEUM. ONE-SIXTEENTH NATURAL SIZE. BO., BASIOCCIPITAL; D., DENTARY; EXO., EXOCCIPITAL; FR., PRE- AND POSTFRONTAL (FRONTAL OF LULL); H., POSTORBITAL HORN CORE; MX., MAXILLARY; NAS., NASALS; NH., NASAL HORN CORE; NO., NASAL OPENING; PA., DERMOSUPRAOCCIPITAL (PARIETAL OF LULL); PD., PREDENTARY; PF., POSTFRONTAL; PL., PALATINE; PMX., PREMAXILLARY; Q., QUADRATE; R., ROSTRAL; SO., SUPRAOCCIPITAL; SQ., SQUAMOSAL; N., SINUSES BENEATH POSTFRONTAL BONES; XO., POSTFRONTAL FONTANELLE. (AFTER LULL.)

SUMMARY.

The principal facts now established from the latest study of the Ceratopsian skull and brain case are:

1. The presence in *Triceratops* of a well-defined pineal foramen.
2. That neither the frontals nor parietals are visible from a dorsal view of the skull.

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[1] This foramen appears to go entirely through the bone in specimen No. 2416, shown in figure 2, but in No. 5740, although there is a deep pit, see *v*, figure 1, it appears not to reach the outer surface.

[2] See Bull. Amer. Mus. Nat. Hist., vol. 33, 1914, p. 547.

3. That the prefrontals and postfrontals which in the normal reptilian skulls are lateral elements have in the Ceratopsian cranium shifted their position from a lateral to a dorsal position supported beneath by strong vertical buttresses. That such a change has taken place is further indicated by the fact that in the older and more primitive Ceratopsians the complete coalescence of the post- and prefrontals of opposite sides on the median line has not always been perfected, though I know of no Lance specimens where this complete coalescence has not been completed.

After a study of the brain case in *Camptosaurus*, *Stegosaurus*, *Trachodon*, *Allosaurus*, and *Triceratops* it appears that no matter how diverse the modifications of the external bones of the skull may be, those forming the brain case have the same definite relations to each other and to the brain itself. Lambe considered the postfrontal as including nearly all of that portion of the skull between the horn cores and an area on the lateral surface extending down and back of the orbit to its inferior level. Huene correctly recognized a portion of the lateral area posterior to the orbit as being the postorbital and so it stood until the discovery of the *Brachyceratops* skull which demonstrates conclusively that the postorbital in that genus includes the horn above the eye and that the lateral extension of the postfrontals is not external but internal to the supraorbital horn cores, as shown in figure 4. I can hardly believe, in the light of the *Brachyceratops* skull that the postorbital bone has been so reduced in size in *Triceratops* as indicated by Huene. In a recent paper by Lambe[1] the small bones interposed between the prefrontals and identified as the frontals represented without question the forward ends of the postfrontals.

EXPLANATION OF PLATES.

PLATE 3.

Life restoration of *Triceratops elatus* Marsh. Modelled by Charles W. Gilmore 1915. Based on the mounted skeleton in the United States National Museum. About one-twenty-eighth natural size.

PLATE 4.

Skull and jaws of *Triceratops obtusus* Marsh. Type. No. 4720, U.S.N.M. Viewed from the left side. About one-twelfth natural size.

PLATE 5.

FIG. 1.—Series of eight articulated posterior dorsal vertebrae of *Triceratops*, sp. No. 8091, U.S.N.M. About one-eighth natural size. Viewed from the right side. The transverse processes of the left side are perfectly preserved.

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[1] Museum Bulletin No. 12, Canada Department of Mines, pl. 9, figs. 1 and 2, 1915.

FIG. 2.—Cervical and dorsal vertebrae of *Triceratops calicornis* Marsh. Type. No. 4928, U.S.N.M. About one-eighth natural size. The second vertebrae from the left is the posterior cervical found in the block of sandstone with the dentaries and is here shown in its proper position in the vertebral series.

PLATE 6.

FIG. 1.—Right scapula of *Triceratops*, sp. No. 8013, U.S.N.M. Oblique internal view. Shows the horn-like growth protruding from the inner side of the shaft.

FIG. 2.—Same as above. Direct internal view. Both figures about one-eighth natural size.

PLATE 7.

Posterior view of skull of *Triceratops*, sp. No. 6679, U.S.N.M. About one-eighth natural size.

D. So., dermosupraoccipital; *Ex. oc.*, exoccipital; *Q.*, quadrate; *P.*, parietal; *S.*, indicates the upper extent of the parietal where it underlaps the dermosupraoccipital, at this point the two bones are slightly separated, the intervening space being filled by matrix.

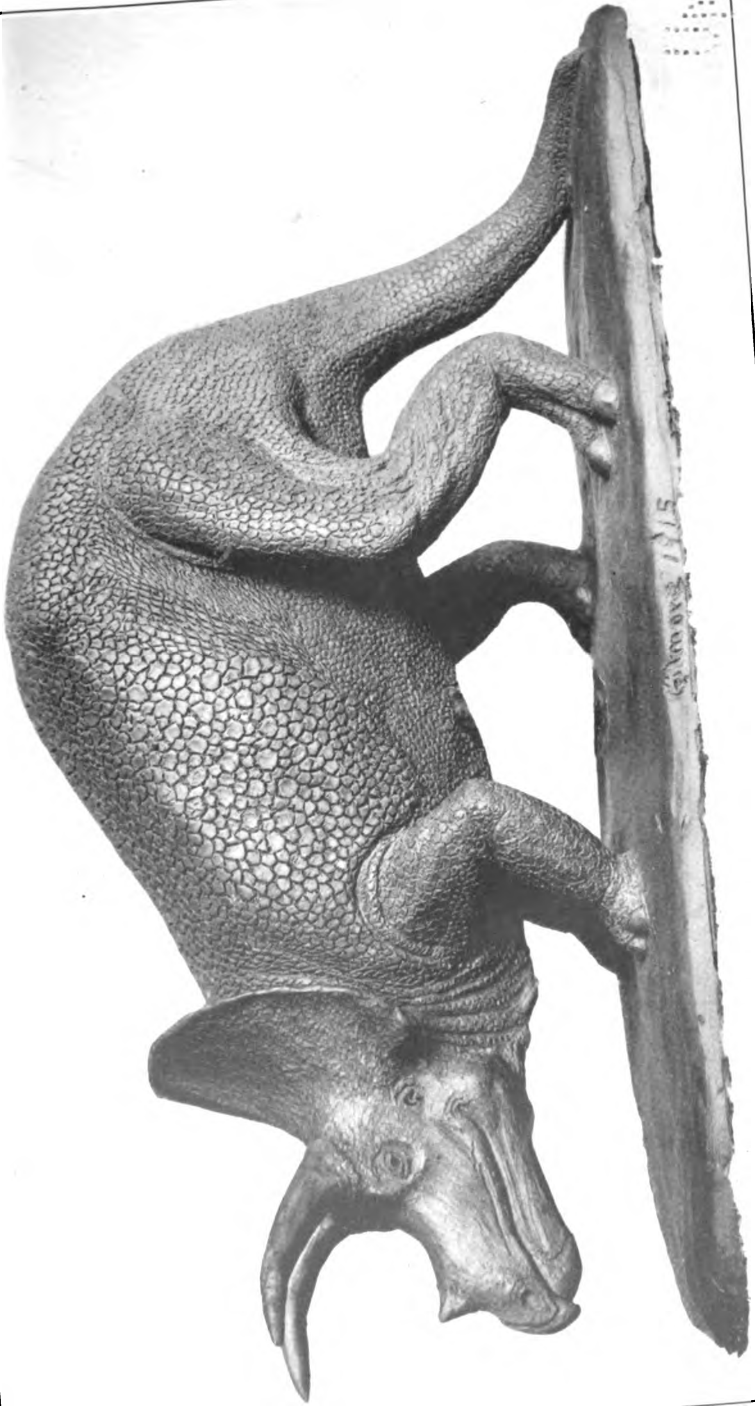
PLATE 8.

Longitudinal section of *Triceratops* skull through the center of brain case No. 5740, U.S.N.M. About one-eighth natural size. Explanatory drawing of this speciment shown in text figure 1.

PLATE 9.

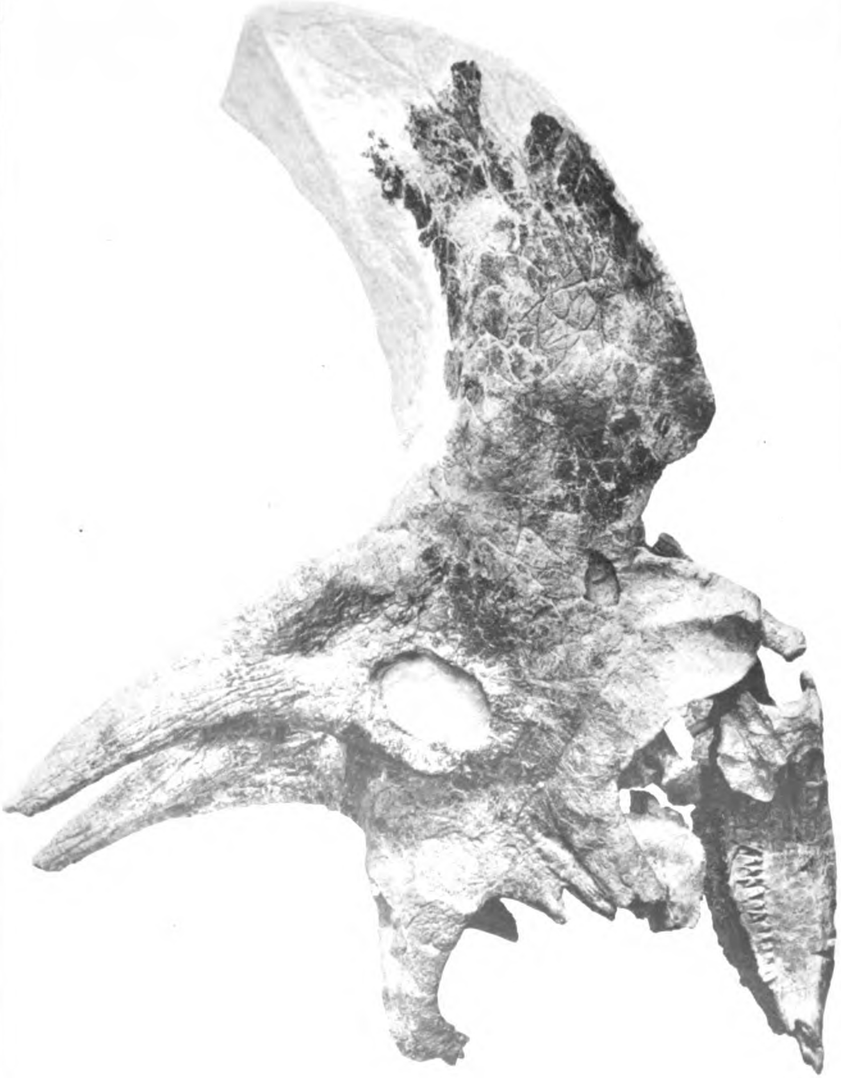
Postorbital horn cores of *Triceratops elatus* Marsh. No. 4708, U.S.N.M. Viewed from the back about one-eighth natural size. This specimen is of interest as showing that the right-horn core was broken off during life, evident from the fact that the stump had healed and rounded over. The size of the horns and other parts belonging to this specimen indicate they belonged to an old individual.

The specimen known by the field designation as "Sk. 11" was collected by the late J. B. Hatcher in 1890 from the Lance formation near Buck Creek, Niobrara County, Wyoming.



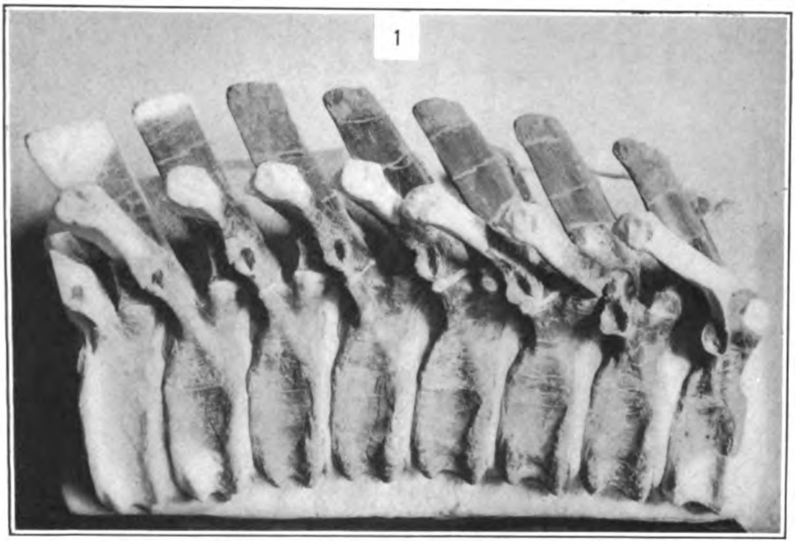
LIFE RESTORATION OF TRICERATOPS ELATUS MARSH.

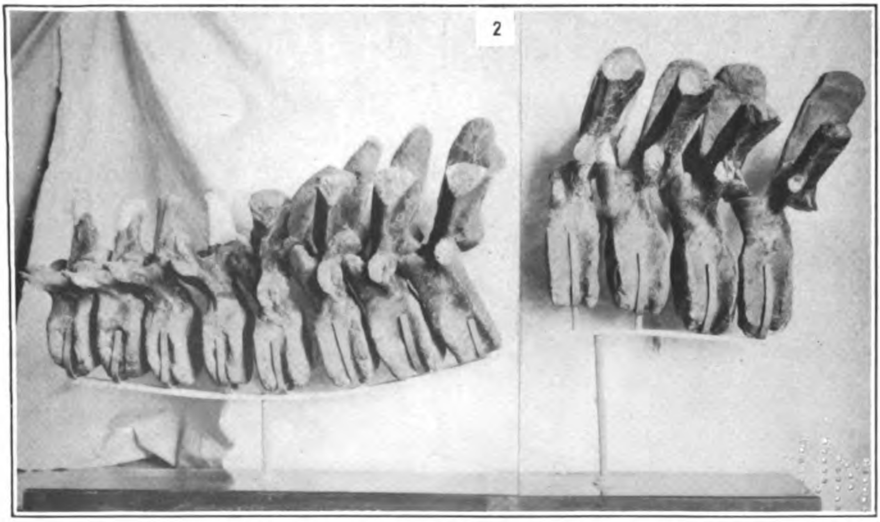
FOR EXPLANATION OF PLATE SEE PAGE 111



Skull of Triceratops obtusus Marsh.

For explanation of plate see page 111.

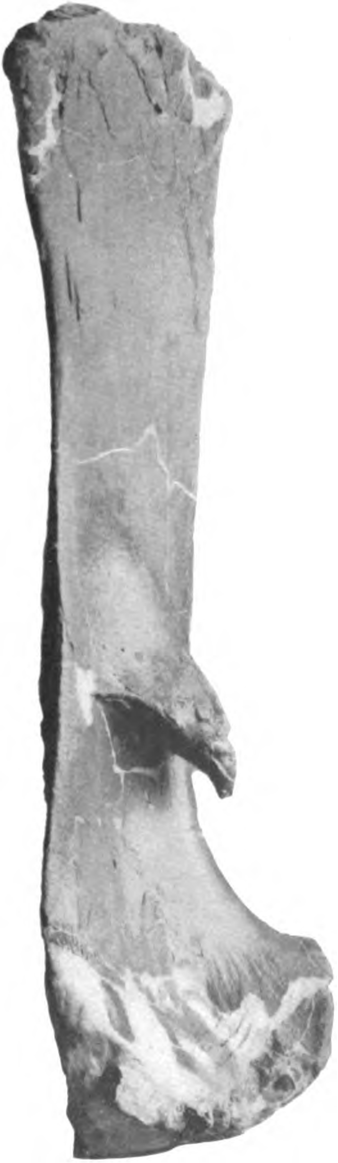




VERTEBRAE OF TRICERATOPS.

FOR EXPLANATION OF PLATE SEE PAGES 111–112.

1



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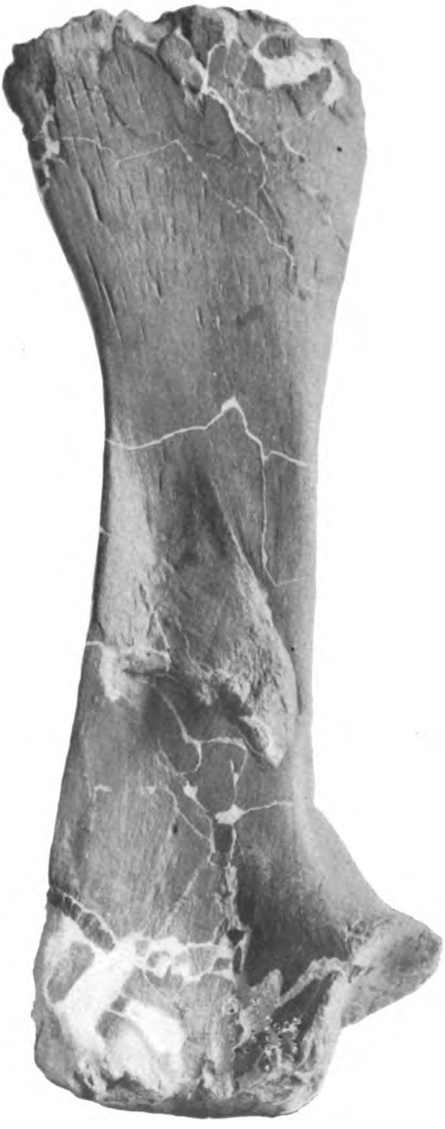
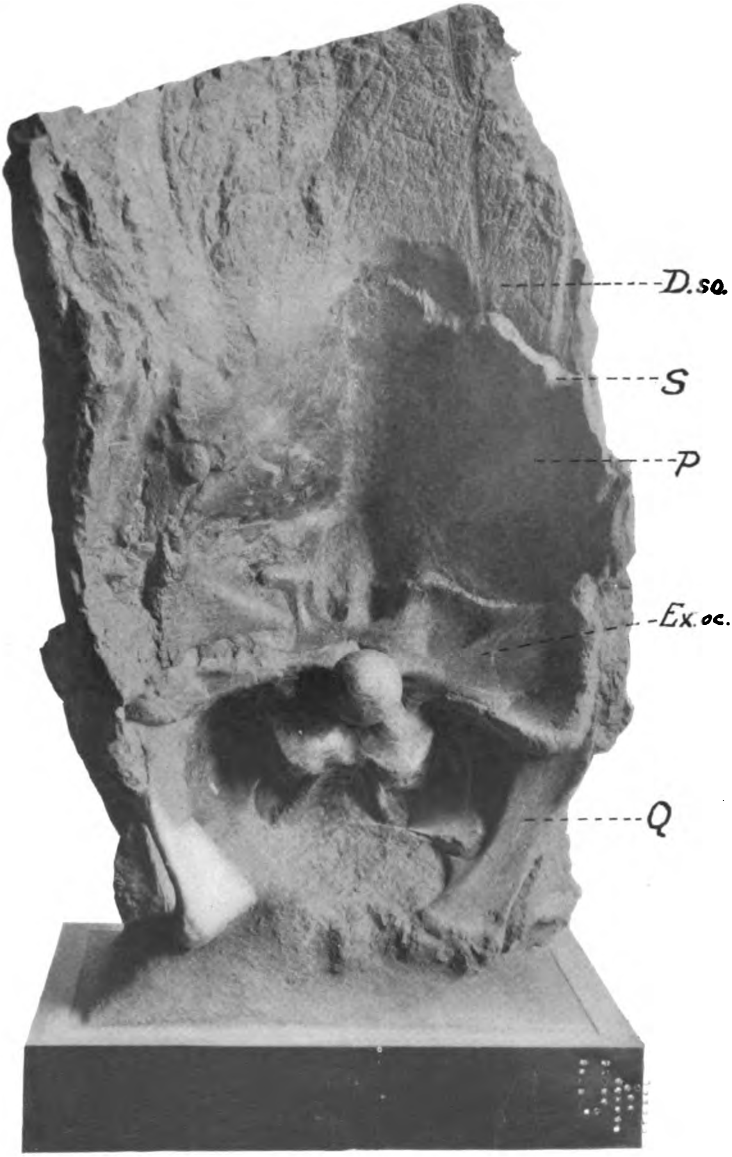


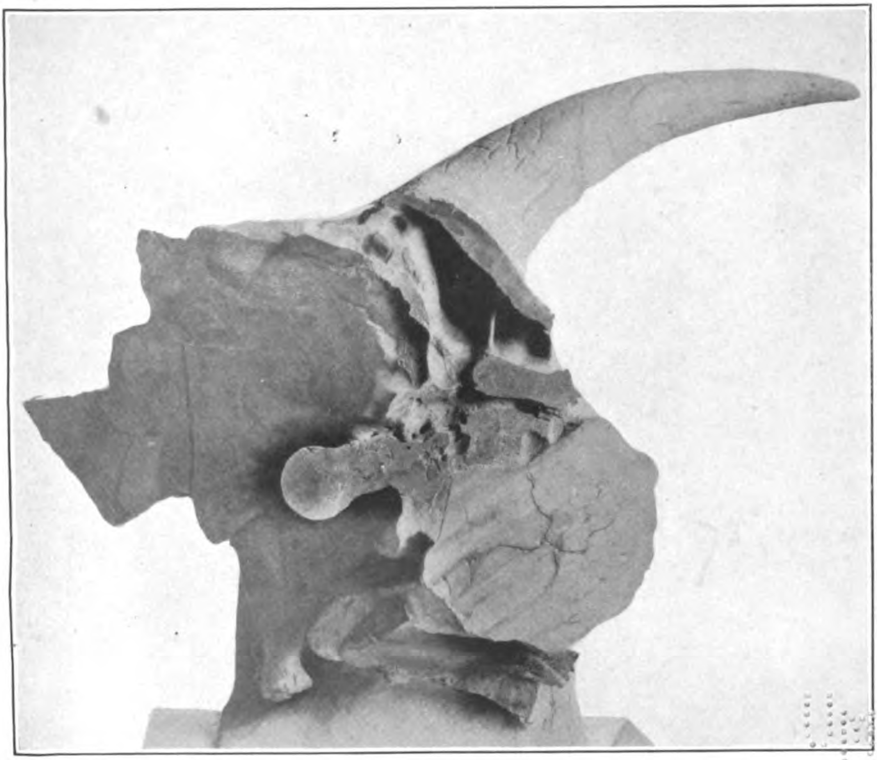
SCAPULA OF TRICERATOPS.

FOR EXPLANATION OF PLATE SEE PAGE 112.



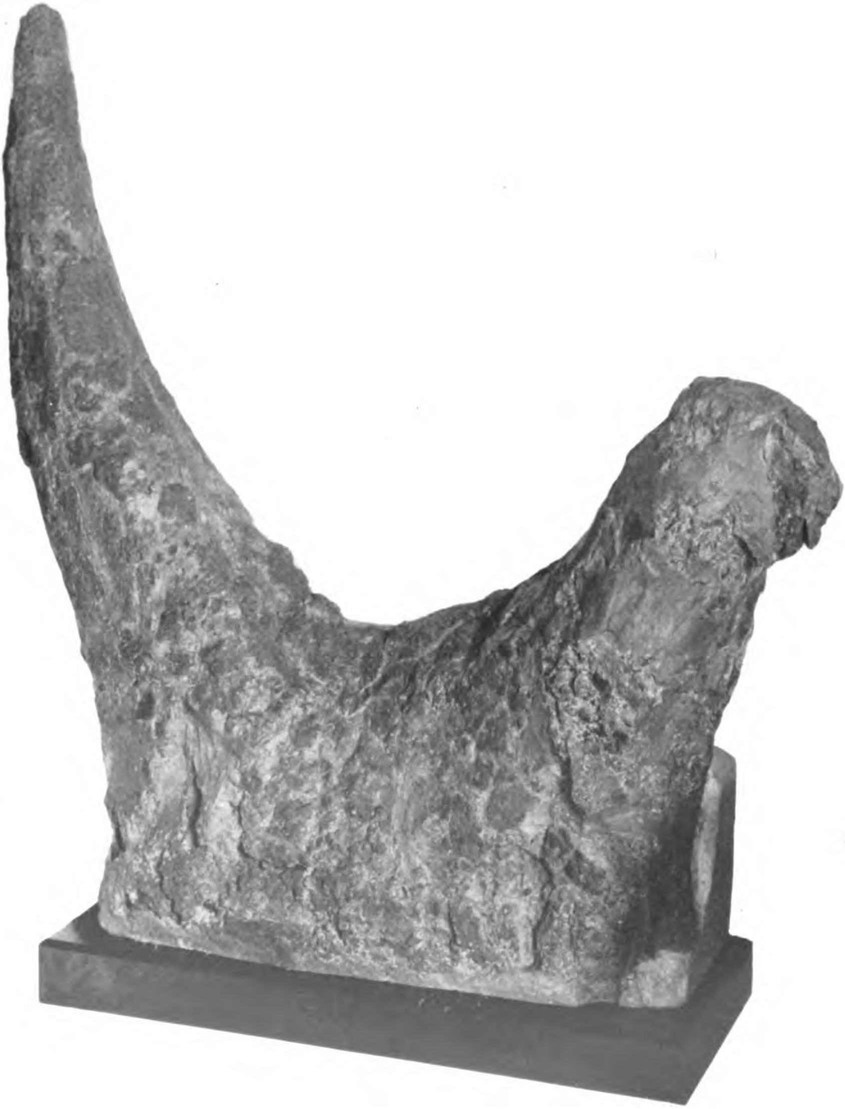
SKULL OF TRICERATOPS.

FOR EXPLANATION OF PLATE SEE PAGE 112.



SECTIONAL SKULL OF TRICERATOPS.

FOR EXPLANATION OF PLATE SEE PAGE 112.



HORN CORES OF TRICERATOPS ELATUS MARSH.

FOR EXPLANATION OF PLATE SEE PAGE 112.

NEW REARED PARASITIC HYMENOPTERA WITH SOME NOTES ON SYNONYMY.

By A. B. Gahan,

Of the Bureau of Entomology, United States Department of Agriculture.

In this paper will be found descriptions of two genera and 12 species of Ichneumonoidea and Chalcidoidea. Notes on synonymy of some species already described are also included. All of the new species are described from reared material and the descriptions are published at this time in order to make the names available for use in economic papers dealing with the host insects.

Superfamily ICHNEUMONOIDEA.

Family ICHNEUMONIDAE.

Subfamily Joppinae.

PHAEOGENES (CENTETERUS) INEPTIFRONS, new species.

This species runs in Foerster's synopsis of the Ichneumonidae, satisfactorily to the genus *Centeterus* except that the head is more transverse than quadrate, though with the posterior orbits full and nearly as broad as the transverse diameter of the eyes. The female is easily separated from any other Phaeogenines known to me by the transverse carina on the frons.

Female.—Length 6.5 mm. Slender; head thorax and abdomen some what shining, finely and nearly uniformly sculptured, the mesopleura and mesosternum with some distinct punctures, most numerous on the mesosternum. Occiput deeply concave; antennae short, 20-jointed, thickened slightly toward the apex, the basal joint of the flagellum a little shorter than the second joint, second and third flagellar joints subequal, and about two and one-half times as long as thick, following joints shorter, the apical one conical, about twice as long as thick, the penultimate joint quadrate; clypeus sculptured like the face, with a few irregularly placed punctures, its anterior margin nearly straight; a line from the antennal fossae to the base of clypeus equal to about one-fourth the distance between the inner eye margins at antennae; face below antennae a little more strongly sculptured than the posterior orbits, with a nearly quadrate slightly elevated area in the middle; frons coarsely transversely striated with a distinct carina about midway between the anterior ocellus and the base of antennae, this carina angulated on each side of the median line so as to form a low upward projecting tooth on each side of the median line and about midway between it and the eye-margin, the lateral extension of the carina terminates at a small low spiracle-like tubercle near the eye margin; notauli impressed on the anterior one-third of the mesoscutum; sternauli distinctly impressed from the anterior margin to the middle of mesopleura; propodeum distinctly completely areolated, the carinae fine, areola one and one-half times as long as broad, rounded anteriorly, the carina between areola and petiolarea weak; petiolarea slightly depressed; venation normal, the areolet slightly narrowed anteriorly; femora very slightly swollen; abdomen about twice as long as the thorax, slender; postpetiole reticulately rugulose, evenly convex, without dorsal carinae; second tergite with the gastrocoeli obsolete; ovipositor sheaths extending beyond the apex of abdomen about the length of sixth tergite. Entirely ferruginous except the eyes, apex of mandibles, apical joint of all tarsi, and the apex of abdomen beyond the fourth tergite, which are black; wings hyaline, the veins and stigma black, the latter with a yellowish spot at inner angle; antennae ferruginous, the apex slightly darker.

Male.—Antennae 22-jointed in the allotype; anterior margin of the clypeus more distinctly convex than in the female; a line from antennal fossae to base of clypeus equal to approximately one-third the distance between the eyes at antennae; frons transversely striated but without the transverse carina and without toothlike projections; apex of fifth tergite and all tergites beyond black.

Type-locality.—Washington, District of Columbia.

Type.—Cat. No. 21614, U.S.N.M.

Host.—*Laspeyresia molesta* Busck.

Six females and two males reared by Mr. E. R. Selkregg from pupae of the above-named host and recorded in the Bureau of Entomology under Quaintance No. 7899.

Subfamily OPHIONINAE.

EXETASTES SUAVEOLENS Walsh.

Campoplex niger PROVANCHER, Nat. Can., vol. 11, 1879, p. 148.

Exetastes provancheri DALLA TORRE, Cat. Hym., vol. 3, 1902, p. 73.

A specimen compared by the writer with Provancher's type and made a homotype is identical with a homotype of Walsh's species in the collection of the United States National Museum compared by Mr. H. L. Viereck.

Family ALYSIIDAE.

Subfamily DACNUSINAE.

DACNUSA IRIDICOLA, new species.

Female.—Length 3 mm. This species is close to *D. laeviceps* Cresson, but is readily distinguished because of the much shorter ovipositor, the narrower and differently shaped first tergite, as well as by the differently colored abdomen; distinguished from *confusa* Ashmead by the prominent ovipositor and the noncrenulate sternauli.

Head, thorax, and abdomen black, the latter sometimes faintly piceus; antennae, mouth parts, and legs, including all coxae, reddish testaceous, the antennae apically brownish; wings hyaline, the stigma and nervures brownish. Head perfectly smooth and polished; antennae 33-jointed in the type, the first joint of the flagellum about four times as long, as thick, and distinctly longer than the second joint; mandibles 4-toothed, there being a somewhat smaller tooth between the large median tooth and the ventral one; distance between the eyes at antennae about equal to median line from antennae to apex of clypeus; mesoscutum shining, faintly sculptured and hairy anteriorly, polished with sparse hairs posteriorly, parapsidal grooves represented by a short shallow strongly curved groove at the anterior lateral angles; a shallow median longitudinal groove divides the praescutum and terminates in front of the scutellum in a deep fovea; sternauli deeply impressed, extending from the anterior to the posterior margin of the mesopleura and perfectly smooth; metanotum with a strong median carina; propodeum densely pilose, rugose with a distinct median longitudinal carina; stigma of forewing extending a little beyond the middle of the radial cell, not as broad at the insertion of the radius as the length of the first abscissa of radius, the latter about equal in length to the intercubitus; second abscissa of cubitus very short; first brachial cell closed at apex; hind coxae unusually hairy at base above; abdomen about equal to the head and thorax in length; the first tergite rugose, hairy, with a distinct median longitudinal carinae on its anterior half at least, the segment widest at the spiracles which are slightly before the middle, its apex broader than its base, and its length nearly twice its greatest width; other tergites all smooth and polished; ovipositor sheaths very slightly curved upward, rather broad, subequal in length to the first tergite and extending beyond the apex of abdomen approximately one-third the length of the first tergite; the ovipositor is straight and very slender; hypopygium rather large and prominent, extending to the apex of pygidium or nearly and in dried specimens forming with it a large mouth-shaped opening.

Type-locality.—Middleburg, Pennsylvania.

Type.—Cat. No. 21615, U.S.N.M.

Host.—*Agromyza laterella* Zetterstedt.

Fourteen females reared by P. R. Myers, May 16–18, 1916, from puparia of the above-named host infesting Iris.

The host of this species is European, and although I have been unable to connect the parasite with any description of a European *Dacnusa*, it may nevertheless prove to be already known there.

Family BRACONIDAE.

Subfamily APHIDIINAE.

TRIOXYS CUPRESSICOLA, new species.

This species is very similar to *coruscanigrans* Gahan, but may be distinguished from it as well as all other American species by the fact that the antennae of the female are 12-jointed and those of the male 13-jointed.

Female.—Length, 1.65 mm. Black, smooth, polished; palpi, antennal pedicel, and first flagellar joint, narrow basal band on all tibiae, all tarsi basally, the first tergite and the two horns at apex of abdomen more or less pale yellowish. Wings hyaline, the stigma and veins pale. Head impunctate; viewed from in front strongly arched above the eyes; eyes converging below, the face rather narrow, polished; clypeus smooth convex, the clypeal foveae large and deep; malar space very short; thorax polished, impunctate; parapsidal grooves absent except at the lateral anterior angles; propodeum polished, distinctly areolated, the petiolar areola rather large, well defined and five-sided; first brachial cell of the forewing nearly effaced; abdomen longer than the head and thorax, smooth, polished, ovipositor sheaths bent downward and about as long as the anal prongs.

Male.—Except for the 13-jointed antennae the male differs from the female only in the usual sexual characters.

Type-locality.—Riverside, California.

Type.—Cat. No. 21616, U.S.N.M.

Host.—*Cerosipha*, new species on authority of Mr. A. F. Swain.

Described from seven females and four males received from Mr. A. F. Swain and reared according to Mr. Swain from an undescribed species of Aphid infesting cypress (*Cupressus*) and belonging to the genus *Cerosipha.*

Subfamily CHELONINAE.

CHELONUS (CHELONELLA) PROTEUS, new species.

Is apparently closest to *atripes* Ashmead, but differs by having the basal joint of flagellum slightly more than four times as long as thick instead of scarcely three times as long as thick; by having the head as viewed from in front decidedly broader than its median length instead of practically as long as broad; by having the posterior lateral angle of the propodeum produced into a rather strong tooth instead of very weakly produced; by having the abdomen more strongly sculptured, the rugosities forming more distinct longitudinal ridges or irregular striations; by having a longer ovipositor and more prominent hypopygium, the hypopygium in all of the 19 female specimens at hand being thrust out from beneath and extending posteriorly beyond the apex of the carapace; the ovipositor from basal hinge to apex of sheaths equal to about two-thirds the length of the abdomen, its apex projecting from the hypopygium a short distance.

Female.—Length 2.8 mm. Black; mandibles at apex, two anterior pairs of tibiae and tarsi entirely, their femora and the hind tibiae and tarsi for the most part dark reddish testaceous. Wings hyaline, the costal vein and stigma dark brown, the other venation brownish testaceous. Antennae 16-jointed, the first flagellar joint only slightly longer than the second, which is equal to the third; clypeus somewhat shining with moderately close rather weak punctures, its anterior margin somewhat produced and slightly elevated; face rugose; frons with rather strong striatiform rugae laterally which are curved downward from the ocelli along the eye margin, the depressed area above the antennae shining with suberased rugae and divided by a weak median longitudinal raised line; vertex transversely rugose, the rugae curving downward behind the eyes; mesonotum with coarse pits or foveae on the posterior middle and the parapsidal furrows strongly foveate, the remainder of mesoscutum more finely sculptured, opaquely rugulose; scutellum shining with suberased punctures; mesopleura coarsely pitted like the posterior middle of mesoscutum; propodeum coarsely rugoso-punctate, with a rather well defined median dorsal areola, the tooth at the posterior lateral angles distinct but not long; nervulus postfurkal by nearly its own length, first and second radial abscissae nearly equal in length and forming a distinct angle at their junction; abdomen at its broadest point narrower than the thorax at tegulae, strongly convex above and more narrowed at apex than usual for the genus; the ventral concavity extends to the apex of the abdomen; ovipositor as described above.

Male.—Agrees with female except that the antennae are 20-jointed in the allotype, the abdomen is more rounded at apex, not at all compressed from the sides, the ventral concavity does not extend to the apex, and at the apex of the abdomen is a deep, nearly circular incision from the middle of which projects a short horn; this aperture in related species is usually very strongly transverse.

Type-locality.—Williamsport, Maryland.

Type.—Cat. No. 21617, U.S.N.M.

Host.—*Stagmatophora gleditschiaeella* Chambers.

Three females and three males reared, according to Mr. W. R. McConnell, of the Bureau of Entomology, from larvae of the above-named host infesting the spines of honey locust (*Gleditsia triacanthos*). Also a number of specimens taken by Mr. P. R. Myers, of the Bureau of Entomology, in the type-locality.

Subfamily BRACONINAE.

BASSUS IMMACULATUS, new species.

Female.—Length 3.5 mm. Resembles (*Microdus*) *Bassus discolor* Cresson as represented by a Viereck homotype in the United States National Museum, but differs in lacking any black markings on the head, thorax, and abdomen, in having the propodeum more evenly and finely sculptured, the second and third tergites very weakly sculptured, the areolet slightly larger, and the sternauli short, weak, and not foveolate, instead of nearly complete and deeply foveolate.

Head perfectly smooth and polished; distance between the eye margins at antennae very slightly greater than from antennae to apex of clypeus; malar space somewhat less than half the long diameter of the eye; postocellar line approximately two-thirds as long as the ocellocular line; a broad rounded ridge between the antennae; occiput very slightly concave; antennae 34-jointed in type, the first flagellar joint the longest, nearly four times as long as thick, second and third joints of flagellum subequal and a little less than three times as long as thick, all flagellar joints longer than thick; thorax smooth, polished; parapsidal grooves deep, not crenulate; transverse furrow at base of scutellum distinctly finely crenulate; propodeum entirely without longitudinal or transverse carinae, finely granularly coriaceous; areolet triangular, subpetiolate; first brachial cell broadly open at apex behind; longer spur of the hind tibiae distinctly less than half the length of basal joint of tarsi; tarsal claw with a distinct basal tooth; abdomen about as long as the head and thorax, the first tergite granularly coriaceous like the propodeum, the second and third tergites with faint traces of similar sculpture, following tergites smooth; ovipositor extending beyond the apex of abdomen about three-fourths the length of the body. Antennae, eyes, ocelli, small blotch at apex of posterior femora above, narrow basal band and broad apex of posterior tibiae, posterior tarsi and the ovipositor sheaths black or blackish; scape beneath testaceous; hind tibiae, except as noted, whitish; remainder of insect immaculate reddish testaceous. Male unknown.

Type-locality.—Baton Rouge, Louisiana.

Type.—Cat. 21618, U.S.N.M.

Four females reared by Mr. C. E. Smith in connection with *Phthorimaea striatella* Murtfeldt and possibly parasitic on that moth. Recorded in the Bureau of Entomology under Chittenden No. 4252[1].

BASSUS USITATUS, new species.

Resembles (*Microdus*) *Bassus simillimus* Cresson, but may be readily distinguished by the nearly smooth, distinctly areolated propodeum, which in *simillimus* is opaquely rugose and not distinctly areolated.

Female.—Length 4.5 mm. The head, viewed from in front, is distinctly broader than long; eyes large, strongly convex; face only slightly convex, smooth and polished with sparse very fine punctures; distance between eyes at antennae slightly greater than from antennae to apex of clypeus; malar space rather short; antennae separated at base by a rounded ridge; viewed from above the head is strongly transverse, polished, with a few very fine punctures, the frontal depression smooth and not bounded laterally by a carina; postocellar line slightly shorter than the ocellocular line; occiput slightly concave; antennae broken, the first flagellar joint a little more than three times as long as thick and a little longer than the second, joints beyond the second decreasing gradually in length; thorax polished with sparse pale hairs; notauli deep and nonfoveolate or nearly so; transverse suture between mesoscutum and scutellum weakly crenulate; mesopleura without sternauli; propodeum nearly smooth, distinctly areolated, the median areola longer than broad and more or less rugulose within; metapleura mostly smooth, more or less rugose below the middle; longer spur of the hind tibiae a little less than half the length of the basal joint of tarsi; areolet of the front wings triangular with a petiole longer than the first radial abscissa; first brachial cell open at apex below the subdiscoideus; abdomen as long as head and thorax combined, entirely smooth and polished, the first tergite dorsally strongly bicarinate on basal half; second tergite with a smooth, poorly defined, transverse furrow which curves forward laterally inclosing an embossed area at base of tergite; suture between the second and third tergites distinct but smooth and not deep; ovipositor extending beyond the apex of abdomen 3.2 millimeters in the type. Antennae, head, prothorax, mesothorax, four anterior legs entirely, and hind tibiae and tarsi, and the ovipositor sheaths black; metapleura, propodeum, abdomen, and the hind coxae and femora reddish testaceous; palpi and apical joint of all tarsi, excluding the claw, more or less pale; wings blackish with several small hyaline patches behind the stigma; veins and stigma blackish.

Male.—Length 5.5 mm. Antennae 34-jointed in the allotype; middle coxae concolorous with the propodeum; otherwise like the female.

Type-locality.—East Wareham, Massachusetts.

Type.—Cat. No. 21609, U.S.N.M.

One female and three male specimens reared by Dr. H. J. Franklin in cages containing breeding material of the cranberry fruit-worm, *Mineola vaccinii* Riley, and probably parasitic on that insect. Two male paratypes deposited in the collection of the Massachusetts Agricultural College, Amherst, Massachusetts.

Subfamily MICROGASTERINAE.

APANTELES STAGMATOPHORAE, new species.

This species is easily recognized by the unusually broad ovipositor sheaths, by the flattened aspect of the thorax, and the smooth polished propodeum which lies in nearly the same plane as the scutellum and mesoscutum.

Female.—Length 3.4 mm. Black; palpi and legs, except coxae, reddish testaceous, the posterior legs somewhat darker than the others; wings hyaline, the stigma and veins dark brown, the former nearly black. Antennae nearly as long as the body, the first flagellar joint about three times as long as thick, apical joints nearly twice as long as thick; occiput polished, remainder of the head subopaque with moderately close weak punctures; distance between the eyes at antennae fully one and one-half times the distance from antennae to base of clypeus; clypeus about twice as broad as long and distinctly separated from the face by a groove; malar space about equal to the median length of clypeus; thorax compressed dorso-ventrally, much broader between the tegulae than the dorso-ventral height, posterior two-thirds of the mesoscutum, scutellum and the propodeum lying in the same plane or nearly so; mesoscutum shining with weak moderately close punctures; scutellum more sparsely and weakly punctured, nearly smooth; triangular plate each side of the scutellum smooth and polished with the suture at base broad and divided by only three or four weak carinae; true metanotum smooth; mesopleurae weakly punctate anteriorly, for the most part polished impunctate; mesosternum flattened and nearly impunctate; propodeum without median longitudinal or transverse carinae and except for a few aciculations at the apical middle, practically smooth and polished or with only subobsolete punctures; hind coxae smooth; transverse part of discoideus and subdiscoideus effaced; abdomen about as long as the thorax and a little narrower, somewhat compressed dorso-ventrally; first tergite slightly broader at apex than base, its basal width about equal to half the width of propodeum at apex, subopaque with very fine obscure aciculations interspersing sparse rather distinct punctures; second tergite fully four times as broad as long down the middle and sculptured like the first but more weakly; following tergites smooth; hypopygium not reaching to the apex of abdomen; ovipositor sheaths three-fourths as long as the abdomen, strongly compressed, blade-like, one-sixth as broad as long or nearly, and fully as broad as the greatest width of the hind femora; ovipositor slender, cylindrical, and slightly curved downward at the tip.

Male.—Antennae much longer than the body, all flagellar joints being at least nearly three times as long as thick; propodeum at the apical middle with distinct aciculations; second tergite a little more than twice as broad at apex as long down the middle; otherwise the male is like the female except smaller, being but 2.4 mm. in length.

Type-locality.—Williamsport, Maryland.

Type.—Cat. No. 21619, U.S.N.M.

Host.—*Stagmatophora gleditschiaeella* Chambers.

Type, allotype, and male paratype reared by W. R. McConnell under cage No. 664; also two female paratypes from the same locality, one of which was collected by P. R. Myers and bears No. 692, the other by W. R. McConnell and bearing No. 689.

Mr. McConnell's specimens were reared from cocoons found in burrows of the host larvae, and these burrows were fully made, with no signs of any pupal host, which is pretty good evidence that they emerged from the mature host larva.

APANTELES EMPRETIAE Viereck.

Apanteles (*Protapanteles*) *empretiae* VIERECK, Proc. U. S. Nat. Mus., vol. 44, 1913, p. 562.

Apanteles (*Apanteles*) *sibinidis* ROHWER, Proc. U. S. Nat. Mus., vol. 49, 1915, p. 227.

Types of *empretiae* Viereck and *sibinidis* Rohwer have been compared and are undoubtedly the same species. Both were originally recorded from the same host, (*Empretia*) *Sibine stimulea* Clemens, and both are from the neighborhood of Washington, District of Columbia.

APANTELES FUMIFERANAE Viereck.

Apanteles (*Apanteles*) *polychrosidis* VIERECK, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 615.

Types of these two species have been compared and the writer is of the opinion that they are synonymous.

Subfamily BLACINAE.

ORGILUS DIORYCTRIAE, new species.

Female.—Length, 4.6 mm. Deep shining black; basal joints of the flagellum, the mandibles, apex of the median and anterior femora and the front tibiae reddish brown, tibial spurs and the ovipositor reddish testaceous, the ovipositor sheaths black; wings subhyaline, faintly tinged with fuscous, the stigma and costal vein black, other venation dark brown. Head a little narrower than the thorax at the tegulae, the occiput concave, vertex punctate near ocelli, nearly smooth laterally and behind and sloping strongly from the posterior ocelli to the occipital carina, which is slightly interrupted above; frons depressed, punctate laterally, smooth medially with a slight median ridge; posterior orbits prominent, almost as broad as the width of the eye, not at all receding, and nearly smooth, except for fine punctures along the occipital margin; ocellocular line slightly less than the postocellar line and equal to about one and one-half times the greatest diameter of a lateral ocellus; face convex below the antennae, moderately punctured, the width between the eyes at antennae a little greater than the distance from the anterior margin of the antennal fossae to the base of clypeus; malar space rather long; cheeks broad and finely closely punctate; antennae 32-jointed in the type, the first flagellar joint three times as long as broad, 10 or 12 apical joints quadrate; mesoscutum and scutellum shining, moderately hairy with weak punctures, the parapsidal grooves foveolate their entire length; propleura strongly rugulose-punctate, smoother along the dorsal margin; mesopleura smooth with the sternauli foveolate; propodeum without carinae, mostly rugulose-punctate, with the base before the spiracles more or less smooth and polished and with an apical depression each side of the middle, which is mostly smooth; sides of propodeum sparsely punctured, except along the apical margin, which is strongly punctured; hind coxae sparsely sculptured; longest hind tibial spur over half the length of first tarsal joint; intercubitus and second abscissa of radius forming a nearly straight line, stub of cubitus beyond the intercubitus slightly longer than the second abscissa of cubitus; abdomen slightly longer and a little narrower than the thorax, the first tergite entirely and the second for the most part finely rugulose-punctate, the base, apex, and lateral margins of the second narrowly smooth; tergites beyond the second polished; ovipositor about 4 mm.

Male.—Is like the female except that apical antennal joints are not quadrate but longer than broad, the base of the flagellum is black like the remainder, and the second tergite is almost sculptureless.

Type-locality.—Patrick's Creek, California.

Type.—Cat. No. 21620, U.S.N.M.

Host.—*Dioryctria xanthaenobares* Dyar on *Pinus attenuata.*

Ten females and one male reared by J. M. Miller September 15, 1916, and recorded in the Bureau of Entomology under Hopkins U. S. No. 14265*k*.

ORGILUS MELLIPES Say.

Microgaster mellipes SAY, Bost. Journ. Nat. Hist., vol. 1, pt. 3, 1836, p. 261.
Microgaster mellipes (Say) LECONTE, Writings Thom. Say Entom., vol. 2, 1859, p. 712.

Say's description of this species, the type of which is lost, indicates the presence of complete parapsidal grooves, a closed radial cell, open second cubital cell, and a more or less fusiform abdomen. This combination of characters excludes the species from the Microgasterinae, while at the same time they agree with *Orgilus*, a genus which the writer would place in the subfamily Blacinae.

Several specimens of what appear to be this species have been reared at Baton Rouge, Louisiana, by Messrs. C. E. Smith and J. L. E. Lauderdale, of the Bureau of Entomology, from *Phthorimaea glochinella* Zeller under Chittenden No. 4150. The writer has chosen a male of this series as a neotype of the species.

Subfamily OPIINAE.

OPIUS MELLEUS Gahan.

Biosteres rhagoletis RICHMOND, Can. Ent., vol. 47, 1915, p. 294.

A series of specimens, including two paratypes, of *rhagoletis*, furnished the United States National Museum collection through the courtesy of Mr. William Colcord Woods, have been compared with the type of *melleus* and agree in every particular.

Subfamily VIPIINAE.

HABROBRACON AMERICANA Ashmead.

Trachyusa americana ASHMEAD, Bull. Colo. Biol. Assoc., vol. 1, 1890, p. 18.

The type of this species in the United States National Museum collection is similar to *H. johannseni* Viereck, but may be separated by the fact that the second radial abscissa is as long or a trifle longer than the first intercubitus and the median carina of the propodeum is more distinct. Also resembles *H. gelechiae* Ashmead, but has the second radial abscissa longer, a better developed median carina on the propodeum, and the abdomen is slightly narrower.

Superfamily CHALCIDOIDEA.

Family CALLIMOMIDAE.

Subfamily MONODONTOMERINAE.

Genus LIODONTOMERUS Gahan.

In the description of this genus the antennae are stated to have two ring-joints. As a matter of fact, there is probably only one true ring-joint, the apparent second ring-joint being a much reduced funicle joint. Study of a series of specimens of *L. perplexus* shows the fourth antennal joint to be usually no longer (often slightly shorter), but usually very slightly broader than the third joint or true ring-joint. In some cases the fifth joint is greatly reduced and might be mistaken for a right-joint. (See fig. 1.)

PSUEDERIMERUS, new genus.

Except for the unicalcarate hind tibiae, the type of this genus appears to be more closely allied to the genus *Liodontomerus* in the subfamily Monodontomerinae than to the type-genus of the Erimerinae. I am unable to see more than the one spur, however, and therefore have placed the genus in the Erimerinae, where it would run in Mr. J. C. Crawford's key to the subfamilies of Callimomidae.[1] Differs from *Erimerus* in the emarginate first and second tergites, in antennal characters and different habitus.

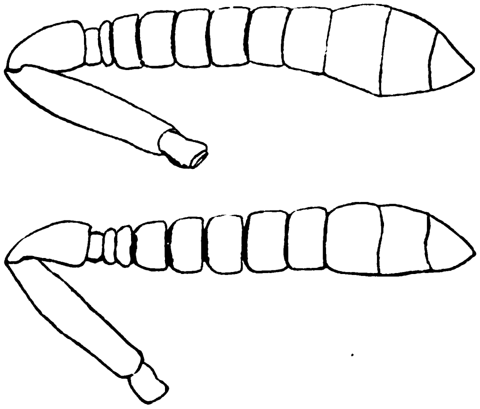


FIG. 1.—LIODONTOMERUS PERPLEXUS. ANTENNA FROM TWO PARATYPE FEMALES ILLUSTRATING VARIATION IN THE FUNICLE JOINTS.

Head transverse. about equal in width to the thorax at tegulae; occiput slightly concave, immargined; ocelli in an obtuse triangle; head, viewed from in front, approximately as long as broad, narrowed below, the malar space much longer than the width of a mandible at base; eyes very slightly diverging below; antennae inserted just above the clypeus; frontal impression for receipt of the scape rather deep, narrow, and extending to the front ocellus; antennae 13-jointed; pedicel as long as the four following joints combined; joint 3 of the antennae is a true ring-joint, joints 4 and 5 also ring-like but broader than joint 3; joints 6, 7, and 8 all broader than long and increasing in breadth and thickness from 6 to 8; joints 9 and 10 very slightly broader than long, subquadrate; club broader than the funicle, about equal in length to the four preceding funicle joints, 3-jointed, the suture between the penultimate and last joint very indistinct; pronotum transverse, somewhat conically produced, the dorsum and sides rounded; mesoscutum broader than long, with distinct sharply curved parapsidal grooves; axillae broadly separated; scutellum nearly flat, without a cross furrow; propodeum short, without lateral folds or spiracular sulci and without distinct median carina; marginal vein equal to about twice the postmarginal which is short and subequal to the stigmal; fore and hind femora somewhat swollen, the latter pair not serrate beneath; hind tibiae straight; abdomen of the female about equal in length to the head and thorax combined, viewed from above ovate, slightly conic at apex, the dorsum slightly flattened, first and second tergites emarginate medially at apex, ovipositor exserted one-fourth the length of abdomen; abdomen of the male oval, flattened above, not longer than the thorax. (See fig. 2.)

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[1] Proc. Ent. Soc. Wash., vol. 16, 1914, p. 128.

Type of the genus—*Pseuderimerus mayetiolae*, new species.

PSEUDERIMERUS MAYETIOLAE, new species.

Female.—Length 1.8 mm. Head viewed from above approximately twice as broad as long, the posterior orbits narrow; postocellar line equal to twice the ocellocular, the latter line only a little greater than the greatest diameter of a lateral ocellus; head and thorax with fine, shallow, rugulose-punctate sculpture and covered with short whitish pile; pleura more weakly sculptured than the dorsum of thorax; propodeum laterally weakly sculptured, medially distinctly rugose; wings hyaline, the area immediately behind the marginal vein very faintly tinged with yellowish; abdomen above and below finely, shallowly, aciculately sculptured. Head and thorax aeneous, abdomen mostly black, tinged with brassy in some lights; antennae black, only the apex of club faintly brownish; coxae all aeneous, the legs otherwise entirely testaceous; ovipositor sheaths black.

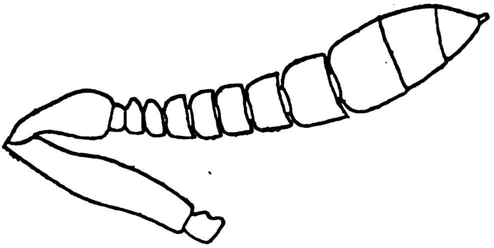

FIG. 2.—PSEUDERIMERUS MAYETIOLAE. ANTENNA OF A PARATYPE FEMALE.

Male.—Length 1.5 mm. Differs from the female as follows: The posterior orbits are much broader and not receding from the eye margins, but extending back a distance about equal to the transverse diameter of the eye before beginning to recede; the ocellocular and postocellar lines are nearly equal, the former being several times as long as the diameter of the rather small lateral ocellus; the abdomen is no longer than the thorax, sculptured as in the female, with a large testaceous or yellowish patch medially both above and below.

Type-locality.—Altamount, California.

Type.—Cat. No. 21621, U.S.N.M.

Host.—*Mayetiola destructor* Say on the authority of Mr. C. M. Packard.

Eight females and six males reared by Mr. Packard and recorded in the Bureau of Entomology under Webster No. 13346. The type and allotype, according to the labeling, are the parents of one of the male paratypes, all three of these specimens bearing, in addition to the Webster number, Martinez No. 17211. Three other paratypes are from Altamount and bear Martinez No. 17215. Four paratypes are from Benicia, California, three of these bearing Martinez No. 17204, and one Martinez No. 17218. Four paratypes under Martinez Nos. 1724, 1717, and 1748 are from Concord, California.

Adults of this species emerge from the puparia of the host. The parasite oviposits in the host puparium and its larva feeds externally upon the host larva within the puparium.

Family PTEROMALIDAE.

HETEROSCHEMA, new genus.

Female.—Antennae slightly above the middle of the face with three ring joints, a five-jointed funicle, and the club distinctly three jointed, antennal pedicel about equal to or a little shorter than the first funicle joint; head strongly transverse, the occiput immargined, scarcely at all concave; posterior orbits narrow and strongly receding; ocelli in a low triangle; left mandible three-dentate, the right four-dentate, anterior margin of the clypeus straight, face broad, slightly convex; thorax robust, the pronotum short, strongly transverse; mesoscutum nearly twice as broad as long, the parapsidal grooves deeply impressed anteriorly, effaced behind the middle; scutellum convex, with a distinct cross-furrow at the apical fourth; propodeum short, with a distinct neck, and a strong transverse carina which separates the neck from the rest of the propodeum, also with a strong median longitudinal carina; propodeal spiracles oval and very close to the base; postmarginal vein twice as long as the stigmal; abdomen conic ovate, with a very short smooth petiole which barely extends beyond the apex of the neck of propodeum; first tergite beyond the petiole comprising a little less than half the total length of the abdomen.

Type of the genus.—*Heteroschema prima*, new species.

HETEROSCHEMA PRIMA, new species.

Female.—Length 1.9 mm. Head and thorax black; abdomen metallic blue-green; scape testaceous, pedicel and flagellum black; coxae and all femora black, the femora at apex and all tibiae and tarsi testaceous; trochanters also more or less testaceous, wings hyaline, the veins mostly testaceous; tegulae testaceous. Head and thorax with shallow irregular thimble-like punctures, those on the head not as strong as on the mesoscutum; first joint of funicle about one and one-half times as long as thick, following joints slightly shorter; club not thicker than the funicle; lower part of face with striae converging toward the mouth; frontal depression small and moderately deep; ocellocular line a little longer than the lateral ocellar line, slightly more than half as long as the postocellar line; propodeum much more finely sculptured than the scutellum; forewing more sparsely ciliated than usual, the basal portion to the junction of the submarginal and the marginal veins entirely bare, the middle of the wing behind the marginal vein with distinct sparse cilia, the apical portion beyond the apex of the stigmal vein more closely ciliated. Abdomen smooth and polished except the fifth and sixth tergites which are weakly lineolated.

Male.—Agrees with the female except that it is slightly smaller, and the abdomen is shorter, more elliptical with the fifth and sixth tergites less obviously lineolate-reticulate.

Type-locality.—Tempe, Arizona.

Type.—Cat. No. 21622, U.S.N.M.

Host.—*Agromyza gibsoni* Malloch.

Eight females and seven males reared from larvae by F. H. Gates and recorded in the Bureau of Entomology under Webster No. 12239.

HABROCYTUS SIMILLIMUS, new species.

Female.—Length 2.4 mm. Very similar to small specimens of *H. languriae* Ashmead, but apparently differs as follows: The body appears somewhat more slender; the clypeus is not as distinctly defined, the striations not being terminated at a depressed line or very fine groove which in *languriae* separates the base at least of the clypeus from the face; the spiracular sulci of the propodeum are shallow, though complete; the apex of the scutellum does not show a punctation different from that of the remainder; the body color appears to be more of a blue green, lacking the bronzy tinge of *languriae*, and all of the femora are blackish, sometimes slightly metallic.

Male.—Length 2 mm. Anterior and median femora pale; the posterior femora fuscous except apically; abdomen with a testaceous patch embracing the apex of first and most of the second tergites; other characters, except the usual sexual ones, as in the female.

Type-locality.—Tempe, Arizona.

Type.—Cat. No. 21623, U.S.N.M.

Host.—*Agromyza gibsoni* Malloch.

Seven females and three males reared by Mr. F. H. Gates from the pupa of the above-named host and recorded in the Bureau of Entomology under Webster No. 12239. Antennae and mandibles of a paratype on a slide.

In view of the great similarity between this supposed new species and *languriae* and the further fact that I have received specimens of the latter species from Tempe, Arizona, reared by Mr. Gates from *Languria mozardi*, which, like *Agromyza gibsoni*, is a stem borer in alfalfa and related plants, it would not be surprising if the two species would ultimately prove to be the same.

EUTELUS MAYETIOLAE, new species.

Female.—Length, 2 mm. Is very similar to *Eutelus bruchophagi* Gahan, but easily distinguished by having all the femora pale testaceous like the tibiae and tarsi instead of blackish; by the fact that the clypeus is distinctly aciculate-striate instead of sculptured like the remainder of the face; the eyes are larger and the malar space somewhat less than half the length of the eye; the antennal ring-joints are longer, the second and third being subquadrate instead of very strongly transverse as in *bruchophagi;* the propodeum is rather distinctly wrinkled between the folds, the median carina weak, laterad of the folds very weakly sculptured and shining; the marginal vein is approximately one and one-third times as long as the postmarginal; the stigmal is equal to about two-thirds the postmarginal; the abdomen is slightly shorter than the combined head and thorax, pointed ovate, practically smooth and polished, the first tergite equal to approximately one-third the length of the entire abdomen. The color of the head and thorax is aeneous with rather strong brassy reflections, the legs except coxae pale testaceous, the wings hyaline or with only a very faint discal discoloration; abdomen blackish with greenish metallic reflections on the first tergite; antennal scape testaceous, the pedicel and flagellum dark brown. In other respects the female agrees with the description of *Eutelus bruchophagi* Gahan.

Male.—Length, 1.8 mm. Agrees with description of male *Eutelus bruchophagi* except that the area between the stigmal and postmarginal veins is hyaline. The second and third antennal ring-joints are subquadrate; the funicle joints a little longer than broad, except the two last, which are quadrate or practically so.

Type-locality.—Salinas, California.

Type.—Cat. No. 21624, U.S.N.M.

Host.—*Mayetiola destructor* Say.

Described from 4 females and 15 male specimens reared from puparia of the Hessian fly by Mr. C. M. Packard, and all recorded in the Bureau of Entomology under Webster No. 13346. The type female, one paratype female, and a broken paratype male bear Pasadena No. 16175 and are said to be progeny of one mother. Another paratype female bears Pasadena No. 16176 and is said to be the parent of the allotype and eight paratype males, all of which bear the same number. Still another paratype female under Pasadena No. 16180 is the mother of five male paratypes.

Mr. Packard states that the parasite oviposits in the host puparium. The parasite larva feeds externally upon the host larva within the pupa case and after transforming emerges as an adult from the puparium.

THE BIRDS OF THE TAMBELAN ISLANDS, SOUTH CHINA SEA.

By Harry C. Oberholser,

Of the Biological Survey, United States Department of Agriculture.

The Tambelan Islands are in the southern part of the South China Sea, about 100 miles west of the westernmost point of Borneo and about 150 miles southeast of the Anamba Islands. They consist really of two groups, lying not far apart, and each extending some 13 or 14 miles southeastward and northwestward. With the Tambelan Islands proper we here include the Rocky Islets, or Pulo Mandariki, about 12 miles west-northwest of the northwestern end of the Tambelan group; and Pulo Kayu Ara, or Saddle Island, some 10 or 12 miles farther to the northwest. Both Saddle Island and Pulo Mandariki are faunally part of the Tambelan group.

The islands of the Tambelan group are numerous, but all relatively small. Many of them rise precipitously from the water, or have interior hills of considerable height. The larger islands are heavily forested, but some of the others are mere rocky heaps. Many have coral reefs about their bases.

Only one, Great Tambelan, is inhabited, and its population consists of 500 or 600 Malays. Wild mammals are not numerous on the islands, and consist chiefly of squirrels, rats, bats, and monkeys.

Great Tambelan Island, the largest and highest of all, is in the northeastern group, and is triangular, about 4½ miles on each side. It has several high hills, the highest reaching an altitude of 1,300 feet. A creek, which enters in a northeasterly direction from the western side, nearly divides it into two parts, and forms an advantageous location for the Malay settlement. Many coconut trees grow on the island, and there are also plantations of sago and fruit trees.

Pulo Bunoa, the largest of the southwestern group, is about 4 miles in length from southeast to northwest, and about 2½ miles wide. The highest of its several hills reaches a height of 915 feet. Like Great Tambelan Island, it is thickly forested and has only a few clearings, these along the shore. Pulo Wai is another of the larger islands and occupies the northwesternmost position in the Tambelan Islands proper. It is about 2 miles long and has several peaked hills, the highest of which rises 1,057 feet above the sea.

PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 55—NO. 2262.

The Rocky Islets, or Pulo Mandariki, 12 miles west-northwest of Pulo Wai, comprise two small barren rocky islets, the larger of these rising to a height of 134 feet. Scarcely any vegetation finds a foothold on their inhospitable slopes, and few birds, excepting two species of terns, make their home there.

Saddle Island, well so-called from its sky line, formed by two hills connected by a lower ridge, is about half a mile long and a quarter of a mile in width. Its highest point is 387 feet above the sea. Like the larger Tambelan Islands, it is covered with forest, and is a much more inviting place for mammal and bird life than is Pulo Mandariki.

Dr. W. L. Abbott was apparently the first ornithologist to explore these islands. With Mr. C. Boden Kloss he spent some two weeks here, from August 3 to August 15, 1899. His intinerary is as follows:

Pulo Selindang.—August 3, 1899.

Pulo Gilla.—August 4, 1899.

Pulo Bunoa.—August 5-7, 1899.

Great Tambelan Island.—August 8-12, 1899.

Pulo Wai.—August 12-14, 1899.

Pulo Mandariki.—August 14, 1899.

Saddle Island.—August 15, 1899.

As one result he collected 53 birds, representing 12 species, which, as usual, he presented to the United States National Museum. These, together with Doctor Abbott's field notes on other birds not collected, and the data published by Mr. Kloss,[1] bring the number of avian species now known from these islands collectively up to 22. Following are separate lists of those found on the Tambelan Islands proper, Pulo Mandariki (the Rocky Islets), and Saddle Island.

TAMBELAN ISLANDS.

1. *Demigretta sacra sacra* (Gmelin).
2. *Pluvialis dominica fulva* (Gmelin).
3. *Totanus totanus eurhinus* Oberholser.
4. *Actitis hypoleuca* (Linnaeus).
5. *Orthorhamphus magnirostris scommophorus* Oberholser.[2]
6. *Caloenas nicobarica* (Linnaeus).
7. *Chalcophaps indica indica* (Linnaeus).
8. *Spilopelia tigrina* (Temminck).
9. *Myristicivora bicolor* (Scopoli).
10. *Muscadivores aeneus polius* Oberholser.
11. *Dendrophassa vernans adina* Oberholser.
12. *Anthracoceros convexus* (Temminck).
13. *Sauropatis chloris cyanescens* Oberholser.

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[1] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, pp. 60-68.

[2] New subspecies; see p. 133.

14. *Tachornis infumata* (Sclater).
15. *Hypurolepis javanica abbotti* Oberholser.
16. *Hypothymis azurea opisthocyanea* Oberholser.
17. *Gracula javana prasiocara* Oberholser.
18. *Lamprocorax panayensis heterochlorus* Oberholser.
19. *Motacilla boarula melanope* Pallas.

PULO MANDARIKI.

1. *Cuncuma leucogastris* (Gmelin).
2. *Sterna anaetheta anaetheta* Scopoli.
3. *Anous stolidus pileatus* (Scopoli).

SADDLE ISLAND.

1. *Cuncuma leucogastris* (Gmelin).
2. *Myristicivora bicolor* (Scopoli).
3. *Sauropatis chloris cyanescens* Oberholser.
4. *Lamprocorax panayensis heterochlorus* Oberholser.

Although the above lists do not, of course, comprise the whole avifauna of these islands, they nevertheless give some idea of its complexion. According to Doctor Abbott's observations, birds are relatively scarce and few in species. Those that he succeeded in finding here are, however, of interest, particularly from a distributional standpoint. Judging from the few species that afford any definite clue, the faunal relationships of the Tambelan Islands are with the Anamba Islands rather than with Borneo, although the latter is geographically somewhat nearer.

Only two papers contain any reference to the birds of the Tambelan Islands. These are:

KLOSS, C. BODEN.—Notes on a Cruise in the Southern China Sea. Journal of the Straits Branch of the Royal Asiatic Society, No. 41, January, 1904, pages 53–80.

OBERHOLSER, HARRY C.—A Monograph of the Flycatcher Genera Hypothymis and Cyanonympha. Proceedings of the United States National Museum, vol. 39, February 25, 1911, pages 585–615.

In the following list the birds prefixed with an asterisk are unrepresented by specimens in Doctor Abbott's collection.

Family ARDEIDAE.

DEMIGRETTA SACRA SACRA (Gmelin).[1]

[*Ardea*] *sacra* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 640 (Tahiti Island, Society Islands).

Three specimens:

Adult male, No. 170877, U.S.N.M.; Pulo Wai, August 13, 1899. Length in flesh, 603 mm.

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[1] *Demigretta* is the original spelling of the generic name.

Juvenal female, No. 170876, U.S.N.M.; Pulo Wai, August 12, 1899. Length in flesh, 584 mm. "Iris yellow; feet pale green. Stomach contained small fish."

Juvenal female, No. 170878, U.S.N.M.; Pulo Wai, August 13, 1899. Length in flesh, 578 mm. "Iris yellow; bill dark horny brown, paler beneath at base."

Whether or not these specimens belong really to the typical form of the species must be determined by a thorough study of all the races, for which we have not opportunity at the present time. There are apparently more subspecies than current authors recognize.

Doctor Abbott reports that it was common along the reefs in the Tambelan Islands at the time of his visit, particularly on Pulo Wai, where he saw several pairs; and on Great Tambelan Island, August 8–12, 1899.

Family BUTEONIDAE.

*CUNCUMA LEUCOGASTRIS (Gmelin).[1]

[*Falco*] *leucogaster* GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 257 (no locality: type locality given by Mathews as New South Wales, Australia).

One seen by Doctor Abbott on Saddle Island, August 15, 1899; and a pair about Pulo Mandariki, on August 14, 1899. None of these was collected.

Family CHARADRIIDAE.

PLUVIALIS DOMINICA FULVA (Gmelin).

[*Charadrius*] *fulvus* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 687 (Tahiti Island, Society Islands).

One adult female in winter plumage, taken on Pulo Wai, August 13, 1899. Length in flesh, 254 mm. "Iris dark brown; feet slaty blue; bill black, becoming brownish at base. Shot out of a bunch of three on the reef. Only ones seen."

Family SCOLOPACIDAE.

*TOTANUS TOTANUS EURHINUS Oberholser.

Totanus totanus eurhinus OBERHOLSER, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 207 (Lake Tsomoriri, Ladak, central Asia).

Reported from the Tambelan Islands by Mr. C. B. Kloss,[2] as observed between August 3 and 14, 1899, but without mention of any particular island.

ACTITIS HYPOLEUCA (Linnaeus).

[*Tringa*] *hypoleucos* LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 149 (Sweden).

Two specimens are in the collection:

Adult female, No. 170882, U.S.N.M.; Pulo Wai, August 12, 1899. Length in flesh, 210 mm.

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[1] Species prefixed with an asterisk are not representedby specimens.

[2] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, p. 66.

Adult female, No. 170883, U.S.N.M.; Pulo Wai, August 13, 1899. Length in flesh, 203 mm.

Both of these examples are in worn summer plumage, and have apparently not yet begun to molt. Doctor Abbott mentions seeing several along the seashore of Pulo Wai.

Family OEDICNEMIDAE.

ORTHORHAMPHUS MAGNIROSTRIS SCOMMOPHORUS, new subspecies.

Orthorhamphus magnirostris magnirostris MATHEWS, Novit. Zool., vol. 18, January 31, 1912, p. 226 (not Vieillot).

Subspecific characters.—Similar to *Orthorhamphus magnirostris magnirostris* (Vieillot), from Australia, but upper and lower parts paler.

Description.—Type, adult male, No. 170879, U.S.N.M.; Pulo Wai, Tambelan Islands, South China Sea, August 13, 1899; Dr. W. L. Abbott. Upper parts drab, slightly verging toward hair brown, more grayish on rump and superior tail-coverts, the shafts of the feathers fuscous (these markings most conspicuous on pileum and cervix), the upper tail-coverts much mottled and irregularly barred with smoke gray and light smoke gray; middle rectrices like the rump, barred and mottled terminally with dull light smoke gray; remaining tail-feathers basally drab, succeeded distally by a very narrow bar of fuscous, then by a wide white subterminal band, and finally by a broad terminal band of fuscous, varying to fuscous black; five outer primaries largely fuscous, but first (outermost) quill with a broad white subterminal band, connected by the broad white inner margin with the white base of inner web; second quill with a similar white bar, though only on inner web, and connected with the white base of inner vane; third the same, but with the white areas somewhat brownish; fourth and fifth quills with only base of inner vane and outer two-thirds of middle portion of same vane white; remaining primaries white, with subterminal mottling of fuscous, chiefly on outer webs; outer secondaries basally white, terminally fuscous, but exterior margins of outer vanes pale brownish smoke gray; inner secondaries drab, their outer margins broadly pale smoke gray; tertials drab; innermost rows of lesser wing-coverts drab like the back, with darker shafts; several succeeding rows of coverts fuscous, forming a conspicuous dark wing-bar, followed by a narrower white bar; remaining lesser coverts, with median and greater coverts, pale smoke gray, the shafts slightly darker; superciliary stripe and subocular stripe, connected posteriorly with broad auricular stripe, white; lores, large malar spot, broad stripe on side of crown above the white superciliary, and broad stripe on cheeks, meeting the last behind the white auricular stripe, brownish black; lower cheeks, chin, and upper throat white;

jugulum very pale smoke gray, with shaft streaks of fuscous and dark drab, these deepest and most conspicuous anteriorly; rest of lower parts dull white, the sides, flanks, and particularly lower tail-coverts, slightly washed with cinnamomeous; lining of wing pure white; "iris yellow; feet dirty yellow, claws dark horn brown; bill black, dull yellow at base."

The typical form of this species was first described by Vieillot[1] without indication of locality; but Mr. G. M. Mathews has recently designated its type-locality as Binongka, Celebes. Unfortunately, however, the latter author overlooked Count von Berlepsch's prior designation[2] of Australia as the type region, and also Vieillot's own subsequent statement[3] that Australasia was the patria of the specimen on which he had based the name *Oedicnemus magnirostris.* Furthermore, Dr. A. Menegaux, who, as is well known, has charge of the ornithological collection in the Muséum National d'Histoire Naturelle in Paris, informs me in a letter just received, that the type of *Oedicnemus magnirostris* Vieillot is still preserved in that institution, and that it is a specimen obtained by Péron in Australia! It seems necessary, therefore, now to consider the Australian bird the typical form, of which *Orthorhamphus magnirostris neglectus* Mathews[4] consequently becomes a synonym. In view of this change, the bird from the East Indies, which Mr. Mathews considered typical *Orthorhamphus magnirostris*, is in need of a new designation, which we accordingly provide here.

Besides the type, described above, Doctor Abbott obtained two specimens in the Tambelan Islands. One of these is an adult female (No. 170880, U.S.N.M.), collected, August 13, 1899, on the reef of Pulo Wai, in company with its mate, the type of *Orthorhamphus magnirostris scommophorus;* which two were all that Doctor Abbott saw on this island. Both are in worn summer plumage, and are just beginning to show evidences of molt among the contour feathers.

The third example is a female in juvenal plumage (No. 171128, U.S.N.M.), taken, August 4, 1899, on Pulo Gilla, by Mr. C. Boden Kloss. This bird also is just beginning to molt its contour feathers. It differs from the adult in having the feathers of the upper parts, including scapulars and tertials, conspicuously edged, tipped or distally mottled with light grayish buff; the terminal portion of middle rectrices more broadly barred with dark brown and whitish; the lesser wing-coverts broadly margined with dull buffy; the dark bar on the inner lesser coverts lighter and much obscured by similar light feather edgings; the white bar on lesser coverts more or less broken by dusky markings; the median and greater coverts darker, duller, more brownish, and less uniform, being in places irregularly barred or mottled with dusky, and the tips of the greater coverts broadly white, forming a conspicuous wing-bar, this set off proximally from the remaining portion of the coverts by a narrow dusky bar.

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[1] *Oedicnemus magnirostris* Vieillot, Nouv. Dict. d'Hist. Nat., vol. 23, 1816, p. 231.

[2] Abhandl. Senkenb. Naturf. Gesell., vol. 34, 1911, p. 87.

[3] Encycl. Méth., vol. 1, 1820, p. 339.

[4] Novit. Zool., vol. 18, Jan. 31, 1912, p. 226 (Lewis Island, northwestern Australia).

Measurements of the two adults from the Tambelan Islands are as follows:

Measurements of specimens of Orthorhamphus magnirostris scommophorus.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[1]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
170879....	Male....	Pulo Wai, Tambelan Islands.[2]	1899. Aug. 13	Dr. W. L. Abbott.	......	272	114	74	92.5	47
170880....	Female .	.....do.......	...do.....	.....do............	533	266	113	75	84	43.5

[1] Measured in the flesh by the collector.

[2] Type.

Family LARIDAE.

STERNA ANAETHETA ANAETHETA Scopoli.

Sterna Anaethetus SCOPOLI, Del. Flor. et Faun. Insubr., pt. 2, 1786, p. 92 (Panay Island, Philippine Islands).

Five specimens:

Adult male, No. 170892, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 406 mm. "Bill and feet black; inside of mouth white."

Adult male, No. 170896, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 407 mm. "Feet black; iris dark brown; bill black, extreme tip white."

Adult male, No. 170895, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 394 mm.

Adult female, No. 170894, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 394 mm.

Adult female, No. 170893, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 406 mm.

All are in good plumage; and they belong apparently to the typical race of *Sterna anaetheta*. Doctor Abbott says that this species was present in great numbers on the two Rocky Islets. It evidently breeds there abundantly, although the breeding season was past at this time (August 14).

ANOUS STOLIDUS PILEATUS (Scopoli).

Sterna pileata Scopoli, Del. Flor. et Faun. Insubr., pt. 2, 1786, p. 92 (Philippine Islands).

Three specimens:

Adult male, No. 170890, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 426 mm.

Adult female, No. 170889, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 406 mm.

Adult female, No. 170891, U.S.N.M.; Pulo Mandariki, August 14, 1899. Length in flesh, 426 mm. "Bill and feet black, iris blackish."

These are all in perfect plumage, and belong apparently to the Philippine race. Doctor Abbott says that the species, at the time of his visit, was in considerable numbers on Pulo Mandariki, in company with much greater numbers of *Sterna anaetheta*. These two were about the only avian inhabitants of consequence. Although both had practically finished breeding, Doctor Abbott found some young birds and addled eggs of *Anous stolidus pileatus* in the crevices of the rocks.

Family CLARAVIIDAE.

*CALOENAS NICOBARICA (Linnaeus).

[*Columba*] *nicobarica* Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758, p. 164 (Nicobar Islands, Bay of Bengal).

Seen by Doctor Abbott on Pulo Bunoa, August 5–7, 1899.

*CHALCOPHAPS INDICA INDICA (Linnaeus).

[*Columbia*] *indica* Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758, p. 164 (eastern India).

Recorded from the Tambelan Islands, August 3–14, 1899, by Mr. C. B. Kloss.[1]

*SPILOPELIA TIGRINA (Temminck).

Columba tigrina Temminck, Hist. Nat. gén. Pigeons, vol. 1, 1808–1811, pl. 43 [p. 158] (Batavia, Java).

Doctor Abbott saw some, but collected none, on Pulo Gilla, August 4, 1899. Not noted elsewhere in the Tambelan Islands.

Family TRERONIDAE.

MYRISTICIVORA BICOLOR (Scopoli).

Columba bicolor Scopoli, Del. Flor. et Faun. Insubr, pt. 2, 1786, p. 94 (New Guinea).

Five specimens:

Adult male, No. 170884, U.S.N.M.; Pulo Wai, August 12, 1899. Length in flesh, 387 mm. "Feet blue; claws black."

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[1] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, p. 66.

Adult male, No. 170898, U.S.N.M.; Saddle Island, August 15, 1899. Length in flesh, 407 mm.

Adult male, No. 170897, U.S.N.M.; Saddle Island, August 15, 1899. Length in flesh, 413 mm. "Bill light blue, tip black. Crop filled with wild nutmegs."

Adult female, No. 170899, U.S.N.M.; Saddle Island, August 15, 1899. Length in flesh, 381 mm. "Upper mandible green at base, black at tip; lower mandible greenish leaden, black at tip."

Adult female, No. 170885, U.S.N.M.; Pulo Wai, August 13, 1899. Length in flesh, 394 mm.

These are apparently indistinguishable from specimens taken in the Philippine Islands and on Celebes. Two—No. 170898, U.S.N.M., male, taken, August 15, and No. 170885, U.S.N.M., female, taken, August 13, are molting their contour feathers, mostly on throat, breast, and hind neck. The three other examples are in excellent plumage, though in places somewhat soiled, apparently from vegetable juices. Doctor Abbott reported this species common on Saddle Island, August 15, 1899; and fairly so on Pulo Wai, August 12–14, 1899. He saw it also on Pulo Bunoa, August 5–7, 1899.

Measurements of these Tambelan Islands birds are given below.

Measurements of specimens of Myristicivora bicolor.

U.S.N. M. No.	Sex.	Locality.	Date.	Collector.	Total length.[1]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
170884	Male...	Pulo Wai, Tambelan Islands.	1899. Aug.12	Dr. W. L. Abbott.	387	223	122.5	20.5	7.5	28.5	35
170897	...do...	Saddle Island, Tambelan Islands.	Aug.15	.....do........	413	227	126.5	23.5	9	31.5	40
170898	...do...	.....do..........	...do..	.....do........	407	231	124	25	9	30.5	39
170899	Female.	.....do..........	...do..	.....do........	381	219	119	23.5	.....	28	34.5
170885	...do...	Pulo Wai, Tambelan Islands.	Aug.13	.....do........	394	214	120	24	.....	27	35

[1] Measured in the flesh by the collector.

*MUSCADIVORES AENEUS POLIUS Oberholser.

Muscadivores aeneus polius OBERHOLSER, Bull. U. S. Nat. Mus., No. 98, June 30, 1917, p. 18 (Pulo Siantan, Anamba Islands).

This species was reported from the Tambelan Islands, as observed between August 3 and 14, 1899, by Mr. C. B. Kloss.[2] Although Doctor Abbott preserved no specimens, the subspecies occurring here seems to be without much doubt that of the Anamba Islands.

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[1] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, p. 66.

*DENDROPHASSA VERNANS ADINA Oberholser.

Dendrophassa vernans adina OBERHOLSER, Bull. U. S. Nat. Mus., No. 98, June 30, 1917, p. 20 (Pulo Mata, Anamba Islands).

Doctor Abbott saw this species on Great Tambelan Island, August 8–12, 1899; and on Pulo Bunoa, August 5–7, 1899. He obtained no specimens, but the bird from the Tambelan Islands is probably referable to the Anamba Islands race.

Family BUCEROTIDAE.

ANTHRACOCEROS CONVEXUS (Temminck).

Buceros convexus TEMMINCK, Nouv. Rec. Planch. Col. d'Ois., vol. 2, livr. 89, February, 1832, pl. 530 and text (Java, Borneo, and Sumatra).

Ten specimens:

Adult male, No. 170868, U.S.N.M.; Great Tambelan Island, August 9, 1899. "Iris brownish red; gular skin dark blue; orbital skin bluish white."

Adult male, No. 170869, U.S.N.M.; Great Tambelan Island, August 10, 1899. "Bill and casque yellowish white, black at base [and on] a narrow line along commissure; feet dull leaden, soles yellowish."

Adult male, No. 170853, U.S.N.M.; Pulo Bunoa, August 5, 1899.

Adult male, No. 170856, U.S.N.M.; Pulo Bunoa, August 6, 1899. Weight in flesh, 2¼ pounds. "Iris dark red; bill and casque yellowish white, black at base below; feet dark leaden, soles dull yellow."

Adult male [marked female], No. 170852, U.S.N.M., Pulo Bunoa, August 5, 1899.

Adult female, No. 170870, U.S.N.M.; Great Tambelan Island, August 10, 1899.

Adult female, No. 171129, U.S.N.M.; Pulo Gilla, August 4, 1899. "Stomach contained fruit and lizards."

Adult female, No. 170885, U. S.N.M.; Pulo Bunoa, August 6, 1899.

Adult female, No. 170854, U.S.N.M.; Pulo Bunoa, August 5, 1899

Adult female, No. 170857, U.S.N.M.; Pulo Bunoa, August 6, 1899.

This fine series indicates that the bird of the Tambelan Islands is identical with that of Borneo, Sumatra, and the Malay Peninsula.

All the specimens are in process of molting both quills and contour feathers, but this is not sufficient to interfere with measurements, which are detailed below.

Doctor Abbott reported this hornbill common on Pulo Wai, August 12–14, 1899; on Pulo Bunoa, August 5–7, 1899; and on Great Tambelan Island, August 8–12, 1899.

Measurements of specimens of Anthracoceros convexus.

U. S. N. M. No.	Sex.	Locality.	Date.	Collector.	Total length.[1]	Wing.	Tail.	Culmen from posterior end of nostril.	Height of bill at nostril.	Length of casque.	Height of casque at nostril.	Tarsus.	Middle toe without claw.
170853	Male....	Pulo Bunoa, Tambelan Islands.	1899. Aug. 5	Dr. W. L. Abbott.	800	289	264	155.5	42.5	136	34	57.5	42
170856	...do....	.....do..........	Aug. 6	...do..	838	295	282	161	44	136	44	62	41
170868	...do....	Great Tambelan Island, Tambelan Islands.	Aug. 9	...do..	838	288	291	149.5	43.5	141	40.5	57.2	42
170869	...do....	.....do..........	Aug.10	...do..	800	288	265	149	43	132	31.5	56.5	43.5
170852	[Male]...	Pulo Bunoa, Tambelan Islands.	Aug. 5	...do..	800	293	286	139	41	119	35	56	43.5
171129	Female .	Pulo Gilla, Tambelan Islands.	Aug. 4	...do..	699	260	249	118	36.5	87	18.5	50.5	39
170854	...do....	Pulo Bunoa, Tambelan Islands.	Aug. 5	...do..	749	266	246	123	38	88	18.5	51	41
170857	...do....	.....do..........	Aug. 6	...do..	.....	263	252	123	37.5	98	18	51	39
170855	...do....	.....do..........	...do.	...do..	749	265	257	123	38	94	19	49.5	39
170870	...do....	Great Tambelan Island, Tambelan Islands.	Aug.10	...do..	749	270	253	118	37	90	17.5	51.5	41

[1] Measured in the flesh by the collector.

Family ALCEDINIDAE.

SAUROPATIS CHLORIS CYANESCENS Oberholser.

Sauropatis chloris cyanescens OBERHOLSER, Proc. U. S. Nat. Mus., vol. 52, February 8, 1917, p. 189 (Pulo Taya, southeastern Sumatra).

The single specimen in the collection is an immature male, No. 170886, U.S.N.M., from Pulo Wai, taken, August 13, 1899. This is apparently almost adult; the upper parts are, however, duller and more greenish than in the fully adult condition; there are still some buffy edgings on the frontal feathers; the customary dusky margins on the breast, together with some slight wash of buff, are also present, but both are practically lacking on the white cervical collar; the black nuchal band is broad and conspicuous, and the auriculars almost solidly black. This example measures: Length in flesh,[2] 254 mm.; wing, 110.5; tail, 70; exposed culmen, 43; tarsus, 17.5. It apparently is subspecifically identical with birds from Pulo Taya, southeastern Sumatra, the type locality of this race.

Doctor Abbott observed this species also on Great Tambelan Island, August 8–12, 1899; and on Saddle Island, August 15, 1899.

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[2] Measured by the collector.

Family MICROPODIDAE.

*TACHORNIS INFUMATA (Sclater).

Cypselus infumatus SCLATER, Proc. Zool. Soc. London, 1865 (meeting of June 27), p. 602 (Banjermassin, Borneo).

Seen by Doctor Abbott on Great Tambelan Island, August 8–12, 1899.

Family HIRUNDINIDAE.

*HYPUROLEPIS JAVANICA ABBOTTI Oberholser.

Hypurolepis javanica abbotti OBERHOLSER, Bull. U. S. Nat. Mus., No. 98, June 30, 1917, p. 32 (Pulo Manguan, Anamba Islands).

Birds of this species were seen by Doctor Abbott on Great Tambelan Island, August 8–12, 1899. It is probable that they belonged to the recently described race from the Anamba Islands.

Family MUSCICAPIDAE.

HYPOTHYMIS AZUREA OPISTHOCYANEA Oberholser.

Hypothymis azurea opisthocyanea OBERHOLSER, Proc. U. S. Nat. Mus., vol. 39, February 25, 1911, p. 602 (Pulo Piling, Anamba Islands, South China Sea).

Seven specimens:

Adult male, [marked female!], No. 170866, U.S.N.M.; Pulo Bunoa, August 6, 1899.

Adult male, No. 170865, U.S.N.M.; Pulo Bunoa, August 5, 1899. Length in flesh, 184 mm.

Adult male, No. 171132, U.S.N.M.; Pulo Selindang, August 3, 1899. Length in flesh, 191 mm.

Adult male, No. 170887, U.S.N.M.; Pulo Wai, August 13, 1899. Length in flesh, 184 mm.

Adult made, No. 170875, U.S.N.M.; Great Tambelan Island, August 10, 1899. Length in flesh, 175 mm. "Bill blue, tip black; feet blue, claws black; iris dark brown.

Adult female, No. 170867, U.S.N.M; Pulo Bunoa, August 7, 1899. Length in flesh, 175 mm.

Juvenal female, No. 170864, U.S.N.M.; Pulo Bunoa, August 5, 1899. Length in flesh, 178 mm.

All these are more or less in molt. An immature female (No. 170864, U.S.N.M.) is just like the adult of the same sex except for a slightly paler bill. In both size and color the birds of this species from the Tambelan Islands are identical with those from the Anamba Islands. For detailed measurements of both, consult the writer's paper on the genus *Hypothymis*.[1] Doctor Abbott says that this pretty blue flycatcher was the only small bird that he found on Pulo Bunoa, but that it was fairly numerous and very tame there. It was also common on Great Tambelan Island, August 8–12, 1899, and on Pulo Wai, August 12–14, 1899.

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[1] Proc. U. S. Nat. Mus., vol. 39, Feb. 25, 1911, p. 603.

Family GRACULIDAE.

GRACULA JAVANA PRASIOCARA Oberholser.

Gracula javana prasiocara OBERHOLSER, Bull, U. S. Nat. Mus., No. 98, June 30, 1917, p. 55 (Pulo Piling, Anamba Islands).

Nine specimens:

Adult male, No. 170873, U.S.N.M.; Great Tambelan Island, August 10, 1899. Length in flesh, 330 mm.

Adult male, No. 170859, N.S.N.M.; Pulo Bunoa, August 6, 1899.

Adult male, No. 170858, U.S.N.M.; Pulo Bunoa, August 5, 1899. Length in flesh, 337 mm.

Adult female, No. 170871, U.S.N.M.; Great Tambelan Island, August 9, 1899. Length in flesh, 324 mm.

Adult female, No. 170872, U.S.N.M.; Great Tambelan Island, August 10, 1899. Length in flesh, 324 mm.

Adult female, No. 170860, U.S.N.M.; Pulo Bunoa, August 6, 1899. Length in flesh, 324 mm.

Adult female, No. 170861, U.S.N.M.; Pulo Bunoa, August 6, 1899. Length in flesh, 343 mm. "Iris dark gray; bill red, tip yellow; feet yellow."

Adult female, No. 170863, U.S.N.M.; Pulo Bunoa, August 7, 1899. Length in flesh, 343 mm. "Feet yellow, claws pale brownish horny; wattles yellow."

Adult female, No. 170862, U.S.N.M.; Pulo Bunoa, August 7, 1899. Length in flesh, 330 mm.

Most of these birds show indications of molt in either the quills or contour feathers, some in both. Several have noticeable whitish tips on the feathers of the abdomen, which on one specimen (No. 170860, U.S.N.M.) are very conspicuous.

This series from the Tambelan Islands is interesting, since it considerably extends the range of this subspecies, hitherto reported from only the Anamba Islands. As will be seen from the appended measurements, these birds agree in size with Anamba specimens; nor is there any difference in color.

Doctor Abbott reported the species fairly common on Great Tambelan Island; also the commonest bird on Pulo Bunoa, where he found it feeding on the wild nutmegs.

Measurements of all the specimens collected are as follows:

Measurements of specimens of Gracula javana prasiocara.

U. S. N. M. No.	Sex.	Locality.	Date.	Collector.	Total length.[1]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Greatest length of lappets.	Greatest width of lappets.	Tarsus.	Middle toe without claw.
			1899.										
170858	Male....	Pulo Bunoa, Tambelan Islands.	Aug. 5	Dr. W. L. Abbott.	337	177	84.5	26.5	15.5	20	......	40	32
170859	...do....	.....do.........	Aug. 6	...do..	......	191	86	29.5	16	24	22	39	35
170873	...do....	Great Tambelan Island, Tambelan Islands.	Aug. 10	...do..	330	191.5	89.5	26.5	14	18	17	38	34
170860	Female .	Pulo Bunoa, Tambelan Islands.	Aug. 6	...do..	324	175	81	28	15.5	16	16	39	33
170861	...do....	.....do.........	...do.	...do..	343	178.5	85.5	28	15	23.5	15.5	38	31.5
170862	...do....	.....do.........	Aug. 7	...do..	330	187	88.5	27	15	21	13	39	31.5
170863	...do....	.....do.........	...do.	...do..	343	183	85.5	29.5	16.5	24.5	16	39	31.5
170871	...do....	Great Tambelan Island, Tambelan Islands.	Aug. 9	...do..	324	170	83	28.5	16	14	15	37	32.5
170872	...do....	.....do.........	Aug. 10	...do..	324	178	78.5	27	15	15	13.5	36	32

[1] Measured in the flesh by the collector.

LAMPROCORAX PANAYENSIS HETEROCHLORUS Oberholser.

Lamprocorax panayensis heterochlorus OBERHOLSER, Bull. U. S. Nat. Mus., No. 98, June 30, 1917, p. 57 (Pulo Mobur, Anamba Islands).

Four specimens:

Adult female, No. 170888; U.S.N.M.; Pulo Wai, August 12, 1899.

Juvenal female, No. 171130, U.S.N.M.; Pulo Selindang, August 8, 1899. Length in flesh, 210 mm.

Juvenal (nearly adult) male, No. 170874, U.S.N.M.; Great Tambelan Island, August 9, 1899.

Juvenal male, No. 171131, U.S.N.M.; Pulo Selindang, August 8, 1899. Length in flesh, 216 mm.

The adult female is in worn summer plumage and has apparently not yet begun to molt. The three juvenal birds, however, are in the midst of the change, this involving both quills and contour feathers; and one of the juvenal males (No. 170874, U.S.N.M) has acquired nearly all its adult plumage. These birds seem to be quite identical with examples of *Lamprocorax panayensis heterochlorus* from the Anamba Islands.

Doctor Abbott reported this starling common on Pulo Wai, August 12–14, 1899; on Pulo Bunoa, August 5–7, 1899; also on Great Tambelan Island, August 8–12, 1899; and he observed it on Saddle Island, August 15, 1899.

Measurements of specimens of Lamprocorax panayensis heterochlorus.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[1]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
170874	Male, juvenal.	Great Tambelan Island, Tambelan Islands.	1899. Aug. 9	Dr. W. L. Abbott.	216	100.5	64	17	8	21	19.5
170888	Female.	Pulo Wai, Tambelan Islands.	Aug. 12	...do..	216	103.5	63.5	17	7	23	19.5

[1] Measured in the flesh by the collector.

Family MOTACILLIDAE.

*MOTACILLA BOARULA MELANOPE (Pallas).

Motacilla melanope Pallas, Reise Versch. Prov. Russ. Reichs, vol. 3, 1776, p. 696 (Dauria, Siberia).

Two or three individuals were seen by Doctor Abbott on Pulo Wai, August 12–14, 1899.

DESCRIPTIONS OF NEW AFRICAN EARTHWORMS, INCLUDING A NEW GENUS OF MONILIGASTRIDAE.

By Frank Smith and Bessie R. Green.

Of the University of Illinois, Urbana, Illinois.

The United States National Museum has a small collection of earthworms made near Lamu on the eastern coast of British East Africa. The collection was made by William Astor Chanler in 1892; and, besides several fragmentary specimens, contains seven worms sufficiently complete for identification.

These specimens though few in number are of much interest. Two new species of *Polytoreutus* are represented, one by five individuals and another by a single specimen. The remaining specimen represents a new genus of the family Moniligastridae. This is the first known occurrence of this family in Africa; and, of still greater interest, the new form has anatomical relations which ally it quite closely with the Haplotaxid genus *Pelodrilus* and with the Megascolecid genus *Acanthodrilus*. It may reasonably be considered as a modern representative of a very early, primitive type of earthworms.

This paper forms No. 126 of the series of contributions from the zoological laboratory of the University of Illinois.

Family MONILIGASTRIDAE.

Setae, simple pointed, sigmoid, four pair per somite. Clitellum on three to six somites, including those bearing genital pores. Spermiducal pores, one or two pair; in or near 10/11, 11/12, or 12/13. Oviducal pores, one pair; in 11/12 or on 13 or 14. Spermathecal pores, one or two pair in 7/8 or 8/9 or 7/8 and 8/9. Esophagus with two gizzards anterior to 10 or two to ten gizzards at beginning of intestine. Last "hearts," two somites anterior to ovarian somite. Meganephric. Spermaries and spermiducal funnels, one or two pair; included in one or two pair of sperm vesicles. Sperm ducts open into prostate glands or independently of them. Ovaries, one pair. Ovisacs, one pair; extend posteriorly from posterior septum of ovarian somite. Spermathecae, one or two pair; with long tubular spermathecal ducts.

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SYNGENODRILUS, new genus.

Prostate gland pores, distinct from spermiducal pores; in close proximity to ventral pairs of setae. Spermiducal pores, one pair; anterior to oviducal pores. Oviducal pores on 14. Gizzards anterior to 10. Posterior "hearts" in 11. Meganephric. Spermaries and spermiducal funnels, enclosed in sperm vesicles. Prostate glands, not connected with sperm ducts. Ovaries in 13. Ovisacs extend posteriorly from 13 through several somites. Spermathecae, without diverticula or appendages.

Genotype.—Syngenodrilus lamuensis, new species.

SYNGENODRILUS LAMUENSIS, new species.

Length, 5.2 cm. Diameter (maximum), 0.4 cm. Somites, 137. Clitellum, 11–16; cingulum. Genital papillae, none obvious. Setae, very small; *aa:ab:bc:cd*=17:1:17:$\frac{10}{11}$; *dd* = $\frac{8}{14}$ circumference. Nephridiopores, first on 4; at anterior margin of somite; some midway between seta line *cd* and mid-dorsal line, others in seta line *cd*. Spermiducal pores, inconspicuous; at anterior margin of 13; slightly ventrad of seta line *cd*. Prostate gland pores, 11, 12, and 13, slightly dorsad of seta line *b*. Oviducal pores, on 14, slightly anteriad and dorsad of *b*. Spermathecal pores, paired in 7/8 and 8/9; slightly ventrad of seta line *cd*. Septa 5/6–7/8, very strongly thickened; septa 8/9–12/13, very thin and somewhat displaced and imperfectly developed. Two gizzards in 8 and 9. Hearts, 6–11. Nephridia, paired; lacking in 1–3 and 11–12. Paired spermaries and spermiducal funnels, inclosed in paired sperm vesicles in 10 and 11. Sperm ducts of each side, much contorted and unite into a single duct, which is without penial or atrial modification. Prostate glands, small; one pair each in 11, 12, and 13. Sperm sacs, one pair included within ovisacs and extend posteriorly to 20. Ovaries, extensive; in 13. Oviducal funnels and ducts, broad and short. Spermathecae, simple; long and slender; paired in 8 and 9.

One specimen, collected at Mkonumbi near Lamu, British East Africa, by William Astor Chanler in 1892.

Holotype.—Cat. No. 16833, U.S.N.M.

The specimen in alcohol is apparently considerably contracted and without obvious color differentiation. Sagittal sections were made from one half of the anterior 22 somites, the other half being left united with the remainder of the worm. The alimentary tract had of course not been freed from dirt before preservation and the clitellar hypodermis proved to be rather difficult to section; and hence the series of sections is defective in some respects, although on the whole it is very good and has made possible the determination of some facts in the anatomy which could not otherwise have been obtained.

External characters.—There is nothing to indicate that the worm is not complete and that the length, 5.2 cm. and the number of somites, 137, are not normal for the species. The maximum diameter, 0.4 cm., is reached in somites 8–14; while anterior to 8 the diameter decreases quite uniformly to the first somite, where it is about 0.15 cm.; posterior to 14, the decrease is very gradual to 0.35 cm. near the posterior end; the trunk being nearly cylindrical throughout. The prostomium is scarcely recognizable and presumably is prolobic. The somites posterior to 15 are each of about one-half the length of the more anterior ones, which are nearly uniform, except that 1–3 are slightly shorter and 15 is about two-thirds as long as 14. Intersegmental grooves are distinct and posterior to 16 each somite has a median ridge on which the setae are borne and which is bounded anteriorly by a distinct annular groove just in front of the setae. The anterior somites are without such annular grooves.

The clitellum is most obvious on 11–14, where the intersegmental grooves are less distinct, but also includes 15 and 16, which have a similar glandular, thickened hypodermis, but are more sharply set off by intersegmental grooves and are somewhat shorter. The clitellum is developed on the ventral as well as on the dorsal surface and is but one cell thick, as in other Moniligastridae. No genital papillae are obvious, although the worm is apparently at the height of sexual activity.

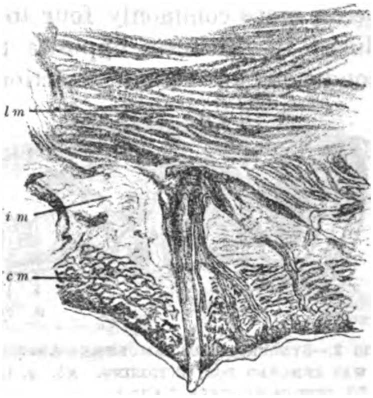

FIG. 1.—SYNGENODRILUS LAMUENSIS. SETA *b* OF SOMITE 7. ×175. *c m*, CIRCULAR MUSCULAR LAYER; *i m*, INTERMUSCULAR LAYER; *l m*, LONGITUDINAL MUSCULAR LAYER.

The setae (figs. 1 and 2) are very small, very closely paired, and no sculpture nor differentiation into special forms as sexual setae has been observed. Posterior to the clitellum, *aa*:*ab*:*bc*:*cd*=17:1:17:$\frac{12}{11}$. *dd* is about $\frac{2}{14}$ of the circumference. These numbers are from averages of several measurements. Length of setae, 0.14–0.19 mm.

The nephridiopores are near the anterior margin of the somites, and the most anterior one found is on the fourth somite. None were found on 10, 11, 12, and 14. Those of 4–9, 13, and 16 are about halfway from seta line *cd.* to the mid-dorsal line, while those of 15 and 17–22 are in the line *cd.* They are obvious only in sections, and hence their position is not known posterior to 22.

There is but one pair of spermiducal pores, and they are recognizable only in sections. They are very close to the anterior border of 13 and somewhat ventrad of seta line *cd.* Three prostate gland pores are present in the sectioned half of the worm and are slightly dorsad of *b* in 11, 12, and 13. Corresponding pores are doubtless present on the unsectioned half of the worm, although they are not recognizable because of their small size. The oviducal pores are on 14 and are a little anterior to and slightly dorsad of *b*. The spermathecal pores are paired in 7/8 and 8/9 and are slightly ventrad of seta line *cd*.

Internal characters.—The structure of the body wall differs from that more commonly found in earthworms. The circular and longitudinal muscle layers are separated by an intervening layer of tissue of an entirely different nature (figs. 1 and 4). It is not stained by the hematoxylin or eosin used, and hence in the sections is sharply differentiated in color as well as in structure. The thickness of the layer is about equivalent to that of the layer of circular muscle fibers. In section it has a very distinctly laminated appearance, there being more commonly four to six laminae, which become much reduced in thickness opposite the intersegmental grooves. Similar conditions are found in sections of a specimen of *Drawida bournei* Michaelsen, for which we are indebted to Doctor Michaelsen, and which is the only material of the family available for comparison. A detailed histological study of this tissue has not yet been attempted by us, but there is no indication of its being fibrous, as the transverse and longitudinal sections present much the same appearance.

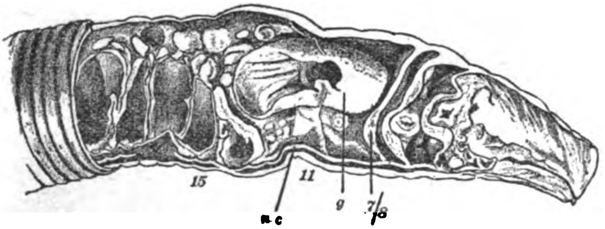

FIG. 2.—SYNGENODRILUS LAMUENSIS. ANTERIOR END FROM WHICH PIECE WAS REMOVED FOR SECTIONING. ×5. *g*, GIZZARD; *n c*, NERVE CORD; 7/8, SEPTUM BETWEEN 7 AND 8.

Septa 5/6–7/8 (fig. 2) are very strongly thickened and the ones posterior to 7/8 are extremely thin and delicate. Those between 7/8 and 13/14 are so extensively displaced and obscure that the exact determination of the internal boundaries of the somites and the assignment of the contained organs to their proper somites is rendered somewhat difficult. What is assumed to be septum 8/9 joins the dorsal wall at 10/11 and the ventral wall at the middle of 10, as indicated by the external metamerism and the setae. Septum 13/14 is attached to the body a little way posterior to 13/14, as indicated by the intersegmental groove. Between septa 8/9 and 13/14 there seem to be but two septal layers connecting with the body wall, although there are evidences of more septa among the organs. The anterior one of these two layers is perhaps the combined septa 9/10, 10/11, and 11/12 and joins the mid-ventral body wall at about the middle of 12 and the mid-dorsal wall at 13/13. The posterior one joins the ventral wall at about the middle of 13 and the dorsal wall at 13/14 and probably is septum 12/13, or possibly 11/12 and 12/13 combined.

The oral end of the alimentary tract is somewhat protruded and has thin walls. In the third and fourth somites the dorsal wall has a heavy mass of glandular and muscular tissue. The esophageal region in 5–7 has relatively thin walls and is followed by two powerful gizzards, one each in 8 and 9 (fig. 2). Posterior to the gizzards the lumen is large and the walls rather thin and highly vascular for the next three or four somites and then the ordinary intestinal character is assumed.

The two gizzards are decidedly more distinct than is indicated in figure 2, which shows them lying in a position oblique to the long axis, and does not well show the marked constriction at the union of the septum 8/9 with the wall of the esophagus, which is shown by sections. The muscular layer is not entirely absent at the constriction, but is reduced in thickness to not over one-eighth of that near the middle of either gizzard.

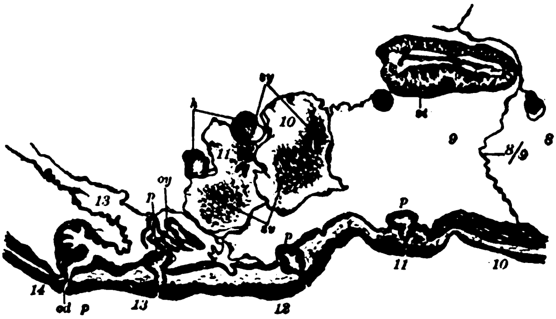

Fig. 3.—Syngenodrilus lamuensis. Longitudinal section reconstructed from several sections passing through the oviducal pore and the prostate glands. ×23. *h*, Heart; *od p*, oviducal pore; *oy*, ovary; *p*, prostate gland; *st*, section through saccular part of spermatheca; *s v*, sperm vesicle; *sy*, spermary; 8, 9, etc., numbers of somites.

Definite "hearts" are present in 6 and 7, and four pairs posterior to the septum 7/8 are assumed to belong to somites 8–11 (fig. 3). Organs aro assumed to belong to any particular somite to which the hearts with which they are associated are thus assigned.

The worm is meganephric and apparently the first nephridia are in the fourth somite. The nephridia associated with the "hearts" of 8 and 9 seem quite certainly to be connected with the nephridiopores of 8 and 9, although the latter one is far removed from its pore because of the displacement of the septa. Nephridia are present in 10, but the nephridiopores have not been located. They are absent in 11 and 12, present in 13, absent in 14, and present in the following somites.

Two pairs of spermaries and of spermiducal funnels are contained in paired sperm vesicles in 10 and 11, respectively (fig. 3).

The sperm ducts (fig. 4) are slender, much contorted ducts, of which those of one side unite posterior to the septum, which we have assumed may represent the fused septa 9/10, 10/11, and 11/12. From the place of union the combined duct has a fairly direct course to the spermiducal pore on the anterior part of 13. The pores are anterior to the place of union of the septum 12/13 with the body wall. There are no prostatic nor atrial modifications of the sperm ducts, nor any development of papillae in connection with the pores. The presence of abundant sperm cells gives evidence of sexual maturity.

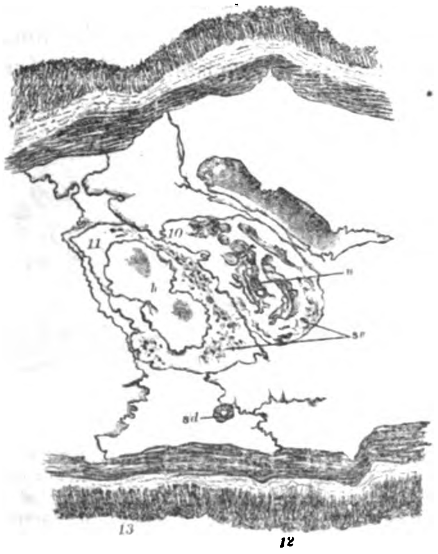

FIG. 4.—SYNGENODRILUS LAMUENSIS. SECTION THROUGH SPERM VESICLES NEAR LATERAL WALLS. ×25. *h*, HEART; *n*, NEPHRIDIUM; *s d*, SPERM DUCT; *s v*, SPERM VESICLES.

We have found nothing in the literature on Moniligastridae which indicates the presence of sperm sacs in addition to the sperm vesicles, yet such organs are clearly present in the species under discussion. These organs are so interesting in character and the relationships which they suggest are of such importance that a somewhat detailed description is desirable. We use the term sperm vesicles for the chambers which inclose the spermaries and the spermiducal funnels and which are called testikelblasen by Michaelsen (1900:9). We use the term sperm sacs for the storage chambers which are contained in somites adjacent to the testicular somites while communicating with the latter by openings through the intervening septa. Michaelsen calls them samensäcken. The sperm vesicles of either side are in intimate contact and suspended by what is assumed to be a compound septum representing septa 9/10, 10/11, and probably 11/12. The spermaries of either side are borne by the anterior walls of the corresponding sperm vesicles which presumably represent septa 9/10 and 10/11, respectively (fig. 3). Parts of the posterior walls of the sperm vesicles, presumably septa 10/11 and 11/12, have a thickened ciliated epithelium which is much folded and constitutes the spermiducal funnels. Numerous small, thin-walled sacs containing mature sperm cells (fig. 5) project posteriorly from the depressions between these folds and occupy space in the somites 11 and 12, although their cavities communicate with the preceding somites. These sacs have the relations of the sperm sacs (samensäcken) of ordinary earthworms and would correspond fully with these organs if the spermiducal funnels were distinct from the sac-bearing part of the septa, and this part of each septum with its sacs were evaginated into the following somite, thus giving rise to a partially multichambered sac. The contents of these small sacs are almost exclusively sperm cells which are nearly or quite mature.

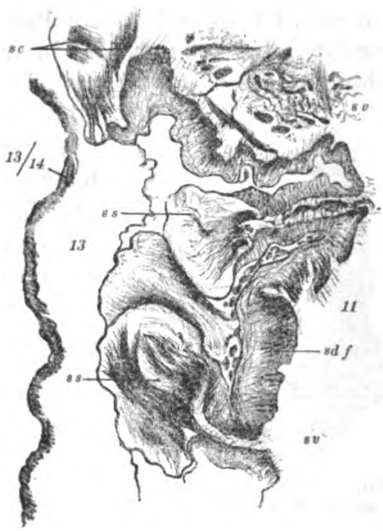

Fig. 5.—Syngenodrilus lamuensis. Longitudinal section reconstructed from several sections passing through the spermiducal funnel and related sperm sacs of somite 11. ×115. *s c*, Sperm cells; *sdf*, spermiducal funnel; *s s*, small sperm sacs; *s v*, sperm vesicle.

A pair of extensive sperm sacs communicating with the sperm vesicles, extend dorsally and posteriorly to about the twentieth somite and contain masses of developing sperm cells and are included within the anterior part of corresponding ovisacs (fig. 6). The relations of these sperm sacs are much the same as is found in certain limicoline worms among the Naididae, Tubificidae, and Lumbriculidae. We have here a rather remarkable assemblage of sperm-storing chambers suggesting relationships with various groups of Oligochaeta. The suppression of the sperm vesicles and of the small sacs associated with the spermiducal funnels would give a limicoline condition. The suppression of the pair of dorsal sperm sacs and a somewhat further development of the small sacs of the septal walls would give conditions similar to those in one genus of Lumbricidae, numerous Glossoscolecidae, and in many Megascolecidae. A still further suppression of the sperm vesicles would result in a condition similar to that of many other earthworms, including some of the more primitive Megascolecidae and many Lumbricidae.

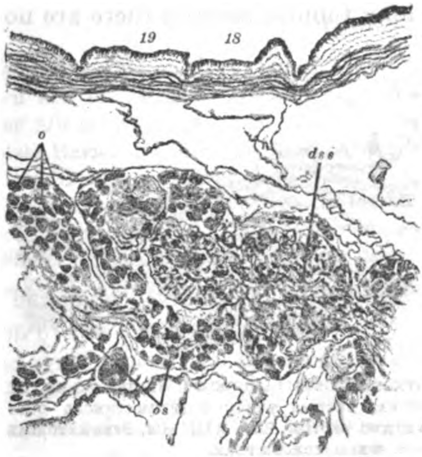

Fig. 6.—Syngenodrilus lamuensis. Longitudinal section through the dorsal sperm sac and the ovisac of one side. ×35. *d s s*, Dorsal sperm sac; *o*, ova; *os*, ovisac.

In the sections a rather small gland, which is assumed to be a prostate gland, is attached to the ventral body wall at a position slightly laterad of *b* in each of somites 11, 12, and 13 (fig 3). Each gland consists of a tubular glandular part of which the lumen is somewhat contorted and which ends in a very short duct having a length about equal to the combined thickness of the hypodermis and circular muscle layer of the body wall (fig. 7). The lumen of the wider glandular part is bounded by an epithelial layer, associated with a thicker glandular layer which is surrounded by a thin, apparently muscular layer, bounded superficially by a very thin epithelium recognizable only in favorable situations. Presumably these glands are in pairs.

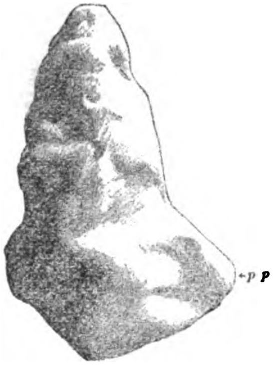

Fig. 7.—Syngenodrilus lamuensis. Wax model of prostate gland reconstructed from sections, posterior view. ×75. *p p*, Narrowed part extending to surface of body at prostate pore.

The ovaries are rather extensive structures in the anterior part of 13 and the oviducal funnels are wide and lead into very short ducts (fig. 3) which open to the exterior at 13/14, slightly laterad of seta line *b*. The ovisacs have already been mentioned. They inclose the dorsal sperm sacs and extend posteriad of 22 (fig. 6). The ova correspond closely in size and granular contents with those of other Moniligastridae. They are about 0.045 mm. in diameter.

There is a pair of spermathecae in each of somites 8 and 9. Each spermatheca includes a duct and a long tubular sac and there are no spermathecal glands nor atrial chambers such as are found in some of the species of *Moniligaster* and *Drawida*. The spermathecae resemble rather those of the primitive genus *Desmogaster*. The duct of the sectioned spermatheca of 9 is about 1.5 mm. long and but 0.07–0.1 mm. in diameter in the greater part of its length. The septum 8/9 follows the duct rather closely, forming a tubular chamber open toward the posterior (fig. 8). The saccular glandular part is somewhat longer than the duct and about 0.35 mm. in diameter, with a lumen of which the diameter is about one-third as great (fig. 8). A compact mass of spermatozoa extends throughout the gréater part of the lumen of

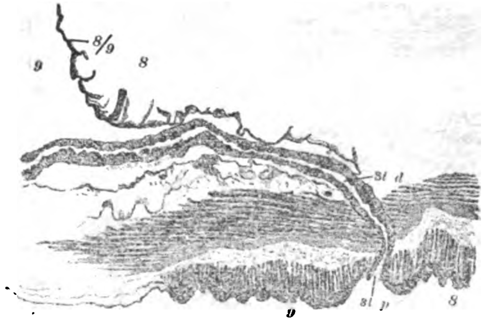

Fig. 8.—Syngenodrilus lamuensis. Semidiagrammatic longitudinal section through spermathecal duct and investing septum, 8/9. ×35. *st d*, Spermathecal duct; *st p*, spermathecal pore.

the saccular part. The openings to the exterior are in 7/8 and 8/9, slightly ventrad of the seta line *cd*.

Lists of the literature on the Moniligastridae are contained in Michaelsen (1900 and 1909) and Stephenson (1915). The literature is quite extensive but has all been accessible in the preparation of this paper.

The relationships of this species are in part quite clear. It has many of the characters of the Moniligastridae and is most nearly allied to the primitive genus *Desmogaster*. This is obvious from the following definitions of these groups by Michaelsen (1900: 109–110):

MONILIGASTRIDAE.

S-förmig gebogene, einfach-spitzige Hakenborsten, zu 8 an einem Segm., gepaart. Gürtel an $3\frac{1}{n}$ oder 4 Segm., im Bereich der männlichen und weiblichen Poren. Männliche Poren 1 oder 2 Paar, auf Intsegmtf. 10/11 oder 11/12 und 12/13; weibliche Poren 1 Paar, auf Intsegmtf. 11/12 oder vorn am 13. oder 14. Segm.; Samentaschenporen 1 oder 2 Paar, auf Intsegmtf. 7/8 oder 8/9 oder 7/8 und 8/9. Oesophagus mit oder ohne Muskelmagen vor den Hoden-Segm.; 2–10 Muskelmagen am Anfange des Mitteldarms. Letzte Herzen 2 Segm. vor dem Ovarial-Segm. Meganephridisch. Hoden und Samentrichter 1 oder 2 Paar, eingeschlossen in 1 oder 2 Paar Testikelblasen; die Testikelblasen sitzen an dem dissep., das zunächst vor der Intsegmtf. der männlichen Poren inseriert ist; die langen Samenleiter münden in je eine Prostata ein. 1 Paar Ovarien in dem Segm., das zunächst vor der Intsegmtf. bezw. dem Segm. der weiblichen Poren liegt; 1 Paar Eiersäcke ragen von der Hinterwand des Ovarial-Segm. nach hinten. 1 oder 2 Paar Samentaschen mit langem, schlauchförmigem Ausführungsgang.

DESMOGASTER ROSA.

Männliche Poren 2 Paar, auf Intsegmtf. 11/12 und 12/13; weibliche Poren vorn am 14. Segm.; Samentaschenporen 1 oder 2 Paar, auf Intsegmtf. 7/8 oder 8/9 oder 7/8 und 8/9. 7–10 Muskelmagen am Anfange des Mitteldarms. Letzte Herzen im 11. Segm. Meganephridisch. 2 Paar Hoden und Samentrichter, eingeschlossen in 2 Paar Testikelblasen an Dissep. 10/11 und 11/12. Prostaten 2 Paar, lang gestreckt. Ovarien im 13. Segm.; Eiersäcke von Dissep. 13/14 nach hinten ragend. Samentaschen ohne atrium-artige Erweiterung und gestielte Drüsen am distalen Ende des Ausführungsganges.

The chief divergence from *Desmogaster* is in the number and position of the gizzards, and especially in the relations of the sperm ducts and sperm sacs. In the position and number of gizzards the resemblance to the Diplocardiinae is close and the departure from the usual condition in Moniligastridae is considerable. In *Desmogaster* there are two pairs of sperm ducts, which remain independent of each other and each of them enters an atrium (prostate gland), as do the two members of the single pair of sperm ducts of all other previously known members of the family. In the new species, on the contrary, the sperm ducts are entirely independent of the prostate glands; moreover, the two ducts of either side of the animal unite into one duct, and there is thus but one pair of spermiducal pores, and these are entirely distinct from the prostate gland pores. This is a condition similar to that which is normal in what are considered to be more primitive forms of Megascolecidae, such as some of the Acanthodrilinae and Diplocardiinae, but with one great difference, namely, that in the latter groups the sperm ducts open far posterior (17–19) to the position in which they open in the new form, which is on the anterior part of 13 and presumably anterior to septum 12/13, which is shifted posteriorly, as described above. Considered with reference to internal metamerism, the sperm duct openings correspond in position quite closely with those of *Pelodrilus violaceus* Beddard, in which the two sperm ducts of either side open separately but quite near each other and nearly midway of the length of 12. In most species of *Pelodrilus* the two pairs of spermiducal pores are on adjacent somites.

In the extensive sperm sacs which extend posteriorly from the sperm vesicles and are included in the ovisacs, we have a character in which the new species differs from the earthworms and strongly resembles certain limicoline forms. The unique feature of this sperm sac development is their inclusion within the ovisacs, but perhaps no great stress should be placed on this character, since it does not seem to be found in the Haplotaxidae, from which the earthworm ancestors are assumed to be derived.

Notwithstanding the important differences above mentioned, it seems to us reasonable to include the new species in the family Moniligastridae, at least tentatively, because of the various important characters in which it is allied with *Desmogaster*. This will entail some modification of the definition of that family as will be seen by a comparison of that given at the beginning of the discussion with the one of Michaelsen. It seems to us desirable to recognize a subfamily Syngenodrilinae for the new genus and a subfamily Moniligastrinae for those previously known.

An attempt to arrange *Pelodrilus*, *Syngenodrilus*, *Desmogaster*, and a primitive Acanthodriline form in a phyletic series has met with difficulty because of the peculiar condition in *Desmogaster* in which the sperm ducts of either side are separate and yet open into prostate glands instead of independently of them. If *Desmogaster* is considered as derived from *Syngenodrilus* then we must assume that it was before the union of the sperm ducts in the latter form or else that after such union they again separated and later came into connection with the prostate glands.

The family Haplotaxidae is represented by a considerable number of species of *Pelodrilus* in the South African, Australian, and New Zealand regions. If these regions actually were connected in the past by such a land area as has been assumed under the name Gondwana, somewhere in that region from Haplotaxid ancestry a Moniligastrid branch may be supposed to have arisen. This branch may have split early into a *Desmogaster* branch which reached and retained a hold in the Burmese and East Indian regions; and a Syngenodriline branch which reached and retained a hold in the tropical East African region. From the latter branch the more primitive Acanthodriline forms may have been derived, and other descendants with but slight change have given rise to our present-day genus *Syngenodrilus.* The suggested relationships are shown in the diagram (fig. 9).

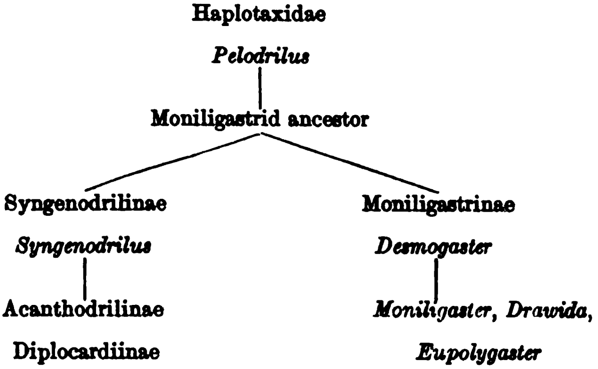

FIG. 9.—DIAGRAM SHOWING SUGGESTED RELATIONS OF SYNGENODRILUS AND RELATED GROUPS.

Because of the lack of adequate knowledge of the earthworm fauna of the territory lying between Northern India and British East Africa, we are, of course, not certain that primitive Moniligastrid forms may not exist in the intervening territory; nor that migration may not have taken place through this territory, or even possibly by the route postulated by Michaelsen (1910: 28), by which the ancestral forms of *Eudichogaster* have been supposed to have passed between Africa and India.

The absence of primitive Moniligastrid species from the Hindustan peninsula and their presence both east and west of that region presents a problem of a sort often encountered in dealing with primitive groups having discontinuous distribution.

The adoption of the ideas of Matthew (1915) on the general principles of geographical distribution will give a very different notion of the sequence of events leading up to the present distribution of earthworms from that held by some writers. These ideas are based on an acceptance of theories of continental development involving the principles of isostasy. They assume a general permanency of the great ocean basins and of the continental shelves. They also assume an alternation of periods of continental elevation, aridity, and erosion with periods of moist, tropical climate and partial submergence. The great land masses are chiefly in the northern hemisphere and at times of maximum elevation are united into one "irregular land mass with three great projections, South America, Africa, and Australasia, radiating out from it into the southern hemisphere." A lowering from present levels of 600 feet "would isolate North America, South America, Asia, Africa, and Australia as separate insular continents."

One important principle of dispersal as announced by Matthew (1915:180) is as follows: "Whatever agencies may be assigned as the cause of evolution of a race, it should be at first most progressive at its point of original dispersal, and it will continue this progress at that point in response to whatever stimulus originally caused it and spread out in successive waves of migration, each wave a stage higher than the previous one. At any one time, therefore, the most advanced stages should be nearest the center of dispersal, the most conservative stages farthest from it."

According to these views we should expect to find the region of origin and the center of dispersal of earthworms to be in the Holarctic region and the more primitive types to be found in the more remote areas as Australia, Africa, and South America; while the more modern, progressive groups are to be expected in Holarctic and adjacent territory. A Gondwana continent would not be needed to account for the present distribution of the Moniligastridae nor an Antarctic continent to explain the distribution of *Notiodrilus* and near relatives and to supply a center of origin and dispersal of earthworms in general, as is sometimes assumed.

Michaelsen (1905:50–55) has expressed views concerning the distribution of the primitive kinds of earthworms which correspond in some ways quite closely with the general principles of distribution enunciated by Matthew.

It seems somewhat surprising that *Syngenodrilus* which seems a very primitive type of earthworm should be found closely associated with such a highly specialized group as *Polytoreutus*, and similarly that *Desmogaster* should be found in a *Pheretima* region.

Family MEGASCOLECIDAE.

Polytoreutus of the subfamily Eudrilinae is a genus which includes about 30 described species, limited in their distribution to a relatively small district in the east-central part of Africa. The two species represented in the Chanler collection involve no change in generic definition.

POLYTOREUTUS CHALONERI, new species.

Length, 10.9 cm. Diameter (maximum), 0.5 cm. Somites, 148. Color (in alcohol), olive buff. Prostomium, prolobic. Setae (posterior to clitellum), *aa:ab:bc:cd*=9:5:8:2; *dd* equals about ½ circumference. Clitellum, 13⅔–⅓18; complete ventrally, 14–½16. Nephridiopores, near seta line *d*. Male pore, median; anterior part of 17. Oviducal pores, posterior part of 14, nearly in line with nephridiopores. Spermathecal pore, median on 18/19. Septa 5/6 and 11/12, somewhat thickened; 6/7–10/11, more strongly thickened. Gizzard in 5. Unpaired esophageal pouches in 9, 10, and 11. Calciferous glands, paired in 13. Sperm vesicles (inclosing spermaries and spermiducal funnels) and sperm magazines in 11. Sperm sacs extend posteriorly from sperm vesicles to about 36. Prostate glands, tubular; open separately into the bursa. Spermatheca, forked at anterior end into two large branches; unpaired median part, without lateral or posterior diverticula.

One specimen, collected at Mkonumbi near Lamu, British East Africa, by William Astor Chanler in 1892.

Holotype.—Cat. No. 16834, U.S.N.M.

Longitudinal sections were made of the half of the anterior 23 somites on the left side of the median sagittal plane. The other half is left united with the remainder of the worm.

External characters.—The olive-buff color of the alcoholic specimen is more pronounced on the dorsal surface than on the ventral. The length of the specimen which is evidently much contracted is 10.9 cm., and the maximum diameter which is at the clitellum is 0.5 cm. There are 148 somites and those anterior to the clitellum are about twice as long as the others and more strongly elevated. The arrangement of the setae in somites posterior to the clitellum is approximately indicated by the formula *aa:ab:bc:cd*=9:5:8:2. *dd* equals about one half the circumference. No evidences of setae were found on 14–16 and only *cd* on 17. The length of seta *b* of somite 9 is 0.25 mm. and of somites just posterior to the clitellum it is about one third greater. No modified genital setae were found. The clitellum includes 14–17 and encroaches slightly on 13 and 18. It is complete ventrally from the anterior border of 14 to the middle of 16 but is incomplete ventrally elsewhere.

The nephridiopores are nearly in seta line *d*, with those of a few anterior somites slightly dorsal to it and others slightly ventrad. The male pore opens mid-ventrally on a small protuberance slightly anterior to the middle of 17. The spermathecal pore is mid-ventral in 18/19. The wall is slightly thickened around each of the two pores but there is no modified genital area. The oviducal pores are on 14, near its posterior border, between seta lines *c* and *d*, but slightly ventrad of the nephridiopores.

Internal characters.—The internal organization of this worm corresponds quite closely with that of other members of the genus. Septa 5/6 and 11/12 are somewhat thickened, while 6/7–10/11 are more strongly thickened. The large thick-walled gizzard is in 5. The unpaired esophageal pouches in 9, 10, and 11 are ventrad of the alimentary tract and open into it by short, wide ducts (fig. 10). These pouches are ovoid, highly vascular bodies. The paired calciferous glands are in 13 and reniform in shape. Hearts are in 9–11; those of 9 are relatively small and those of 10 and 11 quite large. The spermaries in 11 are included in sperm vesicles which seem to unite across the median line in the anterior ventral part of the somite, between the nerve cord and the ventral vessel. The connecting portion is tubular and of rather small diameter. The spermiducal funnels are included in the sperm vesicles; but the greatly enlarged sperm magazines lie outside (fig. 11), and chiefly laterad and anteriad of them. From the sperm magazines the sperm ducts extend through septum 11/12, and then laterad to the body wall between seta lines *a* and *b*, and then posteriad to the anterior part of 18 where each enters a rather small diverticulum of the corresponding prostate gland.

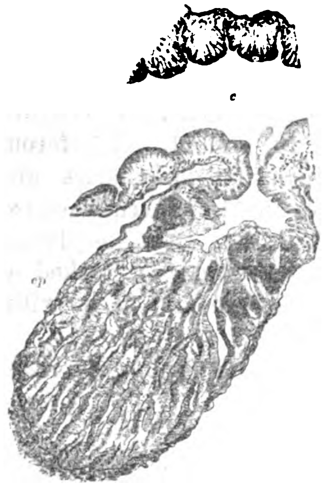

FIG. 10.—POLYTOREUTUS CHALONERI. SECTION THROUGH ESOPHAGEAL POUCH OF SOMITE 10. ×55. *e*, ESOPHAGUS; *e p*, ESOPHAGEAL POUCH.

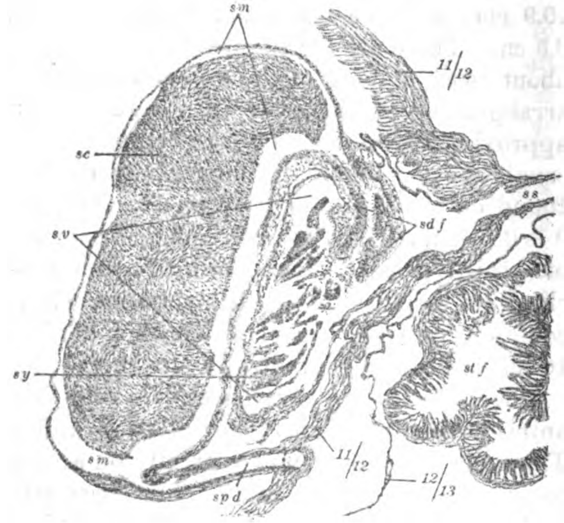

FIG. 11.—POLYTOREUTUS CHALONERI. LONGITUDINAL SECTION RECONSTRUCTED FROM SEVERAL SECTIONS PASSING THROUGH THE SPERM DUCT AND SPERM VESICLE. ×35. *s c*, SPERM CELLS; *sd f*, SPERMIDUCAL FUNNEL; *s m*, SPERM MAGAZINE; *sp d*, SPERM DUCT; *s s*, OPENING INTO SPERM SAC; *st f*, FURCAL BRANCH OF SPERMATHECA; *s v*, SPERM VESICLE (LARGER IN SECTIONS NEARER MIDDLE OF WORM); *sy*, SPERMARY.

The cavities of the sperm sacs are continuous with those of the sperm vesicles (fig. 11, *ss*) and the sacs extend posteriad through a considerable number of somites. They are quite slender as far as the posterior borders of the calciferous glands and the spermathecal furcae (branches), and then are abruptly enlarged and continue as large, more or less irregular bodies, as far as somite 36. Due to the displacement of the calciferous glands and the pushing backwards of the septa, the place of enlargement of the sperm sacs is really about opposite somite 16, as indicated by external metamerism. Each sac has a more or less definite lumen which is accompanied by a branch of the vascular system, at least as far as 23, which is as far as the sections extend.

The prostate glands are each about 10 mm. long and slightly less than 1 mm. in diameter. Each is so bent and folded, that it is included between the septa of 18, although it crowds these outward so as to include most of somites 16-18, as indicated by external metamerism. Near its outlet each gland has a small diverticulum of about 0.5 mm. in length and height, which receives the corresponding sperm duct. The duct of each prostate is quite short, and opens separately into the dorsal part of the cavity of the muscular bursa, which is located medially on the ventral floor of 17, and opens to the exterior slightly anterior to the middle of that somite. The bursa is in height about one-fourth of the diameter of the worm and its lumen is much folded, and presumably during copulation the organ is everted and forms a penis.

The female reproductive organs, in general structure and relations, resemble those of other members of the genus. These relations are indicated to some extent in figure 12 but shown in greater detail in figures 16 and 18 in the species description next following.

Although the female reproductive organs of *Polytoreutus* are more or less similar to those of certain other African genera, to one familiar only with the earthworms of North America, they present somewhat anomalous conditions.

Instead of paired spermathecae with pores anterior to the oviducal pores, we have normally in *Polytoreutus* a more or less fused condition of what was, perhaps, originally a pair of sacs, and also have a single median ventral pore in 18/19 or on 19. The ovarian cells are more commonly found in the ovisacs which are closely related to septum 13/14. There seems to be evidence in support of the view that in some species, at least, these cells are at first related to septum 12/13 and are subsequently shifted to the ovisacs. The oviducts open to the exterior in a normal fashion, but internally each one communicates with the corresponding ovisac and also with the anterior part of the spermathecal apparatus. A further peculiarity of the oviducts of a number of species, is the presence of one or more chambered diverticula, crowded with matured sperm cells and included in a thick-walled enlargement of each oviduct, called by Michaelsen, the eitrichterblase.

In *P. chaloneri* the spermatheca includes a rather large, median sac which branches at the anterior end in 13 into two extensive furcae (fig. 12) and in 17 curves first laterally and dorsally and then ventrally around the bursa and then joins the ventral wall, and communicates with the exterior through the spermathecal pore at the median ventral point of 18/19. The median sac lies ventrad of the nerve cord and between it and the body wall. Each anterior furca or branch curves dorsad and posteriad to a point about midway of the length of the median sac and of the clitellum, but pushes the septa back and so remains in 13, as indicated by the internal metamerism. Each of the pair of oviducts has a rather direct course from the oviducal pore to the enlarged "eitrichterblase" which is attached to the anterior side of 13/14. One sperm-filled diverticulum of the oviduct (samenkämmerchen, Michaelsen) is included in the thick wall of the "eitrichterblase." The remaining part of the oviduct, communicating with the corresponding spermathecal furca near its base, has also a rather direct course.

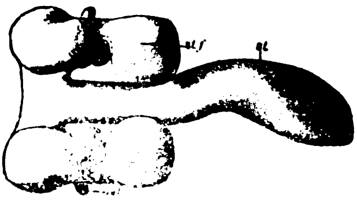

FIG. 12.—POLYTOREUTUS CHALONERI. WAX MODEL RECONSTRUCTED IN PART FROM SECTIONS SHOWING CERTAIN FEMALE REPRODUCTIVE ORGANS. ×7. *od*, OVIDUCT; *os*, OVISAC; *st*, MEDIAN SPERMATHECAL SAC; *st f*, FURCAL BRANCH OF SPERMATHECA.

In *Polytoreutus* the characters of the spermathecae are recognized as of first-class importance for specific distinctions. In a large majority of the 30 or more species already described the spermatheca either lacks anterior furcae or has posterior branches or else the worm has paired copulatory organs near the male pore. Any one of these characters is sufficient to distinguish its possessor from *P. chaloneri.* There are but four species which are not in some such way distinguished from the new form. These four species are *P. baralypton*, *P. finni*, *P. hindei*, and *P. kilindinensis.*

P. baralypton Cognetti (1911) is distinguished from the new form by having the male pore at 17/18 instead of anterior to the middle of 17; by the absence of a muscular bursa associated with the male pore; by the absence of diverticula of the prostate glands at the points of entrance of the sperm ducts; and there are also marked differences between the two species in the number of somites and in the extent of the sperm sacs as well as other minor differences.

P. finni Beddard (1894 and 1901*a*) is distinguished from the new form by its much greater length and tenuity, but especially by having over three times as many somites, over 500, which is a very unusual number. The former species has also much more slender and shorter sperm sacs than has the latter, and the male and spermathecal pores and intervening surface of the former are much more prominent and conspicuous. A more detailed description of *P. finni* would in all probability reveal still further differences.

P. hindei Beddard (1901*b*) is apparently rather close to the new form. It is sharply distinguished by the presence of a strongly developed sucker-like area on the ventral wall of 17 and 18, which includes the male and spermathecal apertures. The sperm sacs of the former species are extremely slender and much shorter than in the latter; the sperm ducts enter the narrow parts of the prostates close to the bursa instead of entering diverticula of the enlarged glandular parts as in the new species; and, finally, the median sac of the former becomes much diminished in size posteriorly, and the furcal branches extend much further posteriorly than in the new form.

P. kilindinensis Beddard (1894 and 1901*a*) differs from the new species in some respects. The male pore is on 17/18 in the former instead of being anterior to the middle of 17, as in the new form; there is a prominent modified genital area on 18 to 21 in the former and none in the latter; there is absence of any "samenkämmerchen" in the former; and the median spermathecal sac is very slender in the former with the spermathecal pore on the middle of 19, while in the new species the median sac is much larger and the spermathecal pore is on 18/19.

POLYTOREUTUS MULTIPORUS, new species.

Length, 10–20.5 cm. Diameter (maximum), 0.3–0.5½ cm. Somites, 264–485. Color (in alcohol), pale gray-brown. Prostomium, prolobic. Setae (posterior to clitellum), $aa:ab:bc:cd=4:2:5:\frac{5}{8}$; *dd* equals about one-half of the circumference. Ventral setae of 19–26 or 27, modified and on papillae. Clitellum, 14–17 and encroaching on 13 and 18. Nephridiopores, between seta lines *c* and *d*. Male pore, median; posterior part of 17. Oviducal pores, posterior part of 14; in seta line *c*. Spermathecal pore, median on 18/19. Accessory spermathecal pores, median on 19/20–24/25 or 25/26. Septa 5/6 and 11/12, somewhat thickened; and 6/7–10/11, more strongly thickened. Gizzard in 5. Unpaired esophageal pouches in 9, 10, and 11. Calciferous glands, paired in 13. "Hearts," large in 10 and 11; smaller in 9. Spermaries and spermiducal funnels, inclosed in sperm vesicles in 11. Sperm sacs extend from sperm vesicles in 11 through many somites. Prostate glands open separately into an eversible muscular bursa and extend posteriorly through a number of somites. Sperm ducts enter prostates not far from their connection with the bursa. Oviducts and ovisacs have the relations usually found in the genus; the former with one or two "samenkämmerchen." Spermatheca, forked at anterior end into two large branches which are connected with the oviducts; unpaired median sac without diverticula extends to spermathecal pore; a median spermathecal branch with several pairs of lateral diverticula extends posteriad from near the pore through about seven somites and has median ventral intersegmental pores on 19/20–24/25 or 25/26.

Five specimens collected at Mkonumbi near Lamu, British East Africa, by William Astor Chanler in 1892.

Holotype and paratypes.—Cat. No. 16835, U.S.N.M.

The paratype from which the drawing was made for figure 13 is left unsectioned. Sagittal sections were made from one-half of the first 20 anterior somites of the type-specimen and similar sections from a varying number of anterior somites in three paratypes. In each instance the uncut half was left connected with the remainder of the specimen.

This treatment of type-specimens is not a common one among students of earthworms, but seems to us to scarcely need defense, since it permits the careful detailed study of the internal organs which is so essential for adequate descriptions in this group of animals. It also avoids the disturbance and occasional loss of organs which sometimes accompanies exploratory dissections.

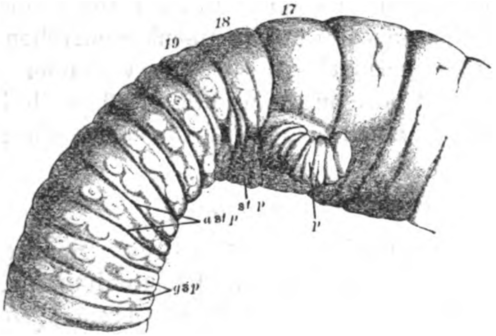

FIG. 13.—POLYTOREUTUS MULTIPORUS. VENTRAL VIEW OF GENITAL REGION. ×5. *a st p*, ACCESSORY SPERMATHECAL PORES; *g s p*, MODIFIED SETAE AND PAPILLAE; *p*, PENIS; *st p*, SPERMATHECAL PORE.

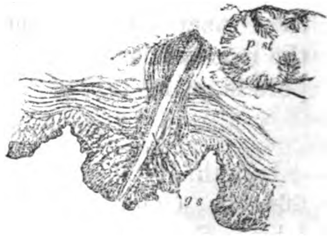

FIG. 14.—POLYTOREUTUS MULTIPORUS. LONGITUDINAL SECTION SHOWING MODIFIED SETA (*a* OF 19). ×35. *g s*, MODIFIED SETA; *p st*, DIVERTICULUM OF POSTERIOR BRANCH OF SPERMATHECA.

External characters.—The length of the type-specimen is 14.5 cm., and its maximum diameter is 0.45 cm. There are about 470 somites in the type and 485 in the largest paratype of which the length is 20.5 cm. The shorter specimens have fewer somites and may not be complete. The color of the specimens indicates that they were pigmented on the antero-dorsal surface in life. The setae are absent on five or six anterior somites and in the clitellar region. Each of all or nearly all of the ventral setae on 19–26 or 27 is surrounded by a glandular papilla (fig. 13) and is modified, being nearly straight (fig. 14) and of fully twice the length and nearly twice the diameter of the ordinary setae which are quite small (fig. 15). Throughout the greater part of the length of the worm the setal distances are about as indicated by the formula given above. The clitellum is much less strongly developed on the ventral side of the somites than elsewhere. It includes 14–17 and encroaches slightly on 13 and 18.

Dorsal pores are lacking. The nephridiopores are rather conspicuous near the intersegmental grooves and between the seta lines *c* and *d*. The male pore is conspicuous on the posterior part of 17, and in one paratype there is a protruding penis (fig. 13), which is directed anteriorly and has a length of about one-half of the diameter of the body. The oviducal pores are near the posterior border of 14, in the seta line *c*, and are rather inconspicuous. The spermathecal pore is a median transverse cleft on 18/19. Inconspicuous, median, intersegmental pores are present on 19/20–24/25 or 25/26 and open into a posterior extension of the spermatheca (fig. 16).

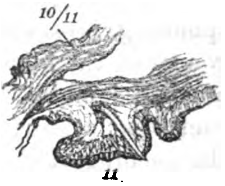

Fig. 15.—Polytoreutus multiporus. Ordinary seta. (*a* of 11). ×35.

Internal characters.—The thickened septa of the anterior somites correspond in position and thickness with those described in most species of the genus. There is nothing peculiar in the alimentary tract, which has a powerful gizzard in 5, unpaired ventral pouches in 9, 10, and 11, and a pair of calciferous glands in 13. Careful attention to the septal relations is necessary, or one is in danger of locating these glands in 15, since they are pushed back with the septum 13/14 past the incomplete septum 14/15. This dislocation is due to the presence of the massive anterior branches of the spermatheca, which nearly fill the space normally belonging to 13. The alimentary tract abruptly widens to form the intestine, slightly posterior to the opening of the calciferous glands into the esophagus. The "hearts" in 10 and 11 are very large, those of 9 are considerably smaller, and there appears to be a still more slender pair of vessels connecting the dorsal and ventral vessels in 8; but the vascular system anterior to 9 has not been carefully studied, and no positive statement can be made concerning a possible doubling of the dorsal vessel in anterior somites.

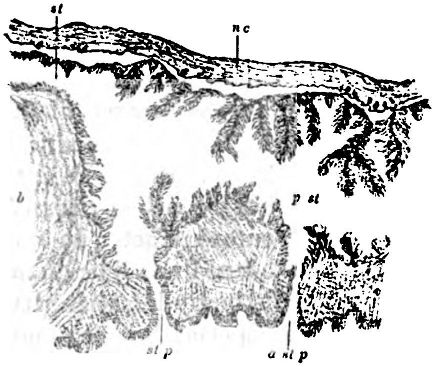

Fig. 16.—Polytoreutus multiporus. Longitudinal section showing the spermatheca near the spermathecal pore. ×35. *a st p*, Most anterior accessory spermathecal pore at 19/20; *b*, edge of bursa; *n c*, nerve cord; *st*, posterior part of median spermathecal sac (through narrow edge); *p st*, posterior branch of spermatheca; *st p*, spermathecal pore at 18/19.

Paired sperm vesicles in 11 include the spermaries, the spermiducal funnels, but not the sperm magazines. From the sperm vesicles the two sperm sacs extend posteriorly as narrow tubes through a considerable number of somites to points near the posterior ends of the prostate glands, and are then enlarged and crowded with sperm masses. In the type-specimen the enlarged parts of the sperm sac extend from about 40 to 80, and in a paratype from 40 to 64. From the ventro-anterior part of each magazine the corresponding sperm duct extends posteriorly along the body wall to the region of the corresponding prostate gland where it turns dorsally and follows the course of the gland for a short distance and then enters it through a small knoblike diverticulum. Each gland is long, tubular, and somewhat contorted. Its diameter is less for a short distance near the opening of the gland into the enlarged muscular bursa. Traced from the bursa the glands curve dorsally, one on either side of the intestine, make an abrupt turn at the points of entrance of the sperm ducts, and extend posteriad, parallel with the long axis of the worm and dorsad of the intestine. In the type-specimen they end in 40, and in one paratype in 38. In another paratype one extends to 28 and the other to 35.

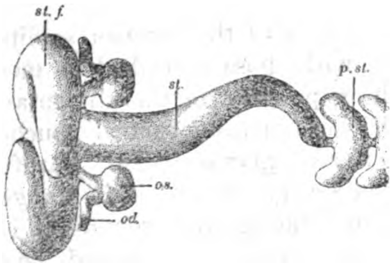

FIG. 17.—POLYTOREUTUS MULTIPORUS. WAX MODEL RECONSTRUCTED IN PART FROM SECTIONS SHOWING CERTAIN FEMALE REPRODUCTIVE ORGANS. ×10. *od*, OVIDUCT; *os*, OVISAC; *p st*, PART OF POSTERIOR BRANCH OF SPERMATHECA; *st*, MEDIAN SPERMATHECAL SAC; *st f*, FURCAL BRANCH OF SPERMATHECA.

The spermatheca is an unpaired tubular organ located ventrad of the alimentary canal, and the median part is ventrad of the nerve cord. The spermatheca forks at the anterior end into right and left branches (fig. 17, *st f*), which are large and encircle the alimentary tract. In one paratype the free ends extend beyond the mid-dorsal line. The diameter of the median part of the spermatheca is distinctly less than that of the proximal parts of the branches. The spermatheca extends posteriorly from the bifurcation along the mid-ventral line close to the body wall until it reaches the bursa around which it curves to the left or right and opens to the exterior mid-ventrally on 18/19.

The wall of the median sac becomes gradually thinner in the part adjacent to the bursa and is quite thin near the pore. Posterior to the pore there is an extension of the spermatheca (fig. 17, *p st*) which has a rather narrow median part in close contact with the body wall and extends posteriad to 25 or 26. Paired diverticula metamerically disposed communicate with the median sac opposite the intersegmental pores in 19/20–24/25 or 25/26 through which the median sac opens to the exterior. The wall of this posterior extension of the spermatheca (fig. 16, *p st*) is identical in structure with that of the spermatheca just anterior to the spermathecal pore in 18/19. The diverticula are free from the body wall and extend laterally to about seta line *b*. The pores are referred to in the definition and in the description of figures as accessory spermathecal pores (fig. 16, *a st p*).

From the oviducal pores on the posterior part of 14, each of the oviducts extends ventrad and then in a quite direct course to the enlargement (eitrichterblase) just anteriad of the corresponding ovisac (figs. 17 and 18B). From this it is continued in a rather direct course to the corresponding furcal branch of the spermatheca with which it communicates. One or two "samenkämmerchen" open into each duct and are more commonly compound with three or four diverticula opening through a common ductule into the oviduct. Figure 18B, *sk* is from a section through the single compound chamber of this kind in the type specimen, and is through the cavities of three such diverticula, all of which communicate with the oviduct through a common opening.

The pocketlike chambers of the ovisacs, besides well-grown ova, contain ovarian cells in various growth stages (fig. 18, A and B). No evidence was found throwing light on the place of origin of the ovarian tissue.

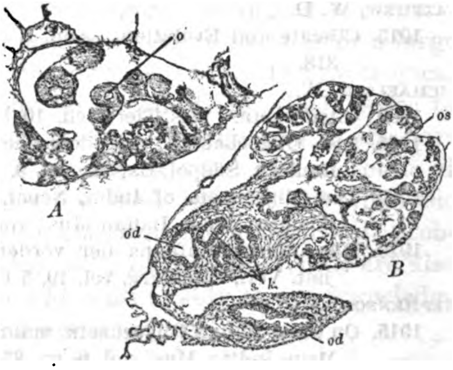

FIG. 18.—POLYTOREUTUS MULTIPORUS. SECTION THROUGH OVISAC. A. ×350. *o*, OVARIAN CELLS IN DIFFERENT GROWTH STAGES. B. ×55. *od*, OVIDUCT; *os*, OVISAC; *sk*, DIVERTICULA OF THE MULTICHAMBERED SAMENKÄMMERCHEN.

It is apparent from the description of the new species that it belongs to the genus *Polytoreutus*. *P. multiporus* differs from all other described species of the genus in the following respects: There are accessory spermathecal pores at 19/20–24/25 or 25/26 which open from the posterior extension of the spermatheca; the ventral setae of 19–26 or 27 are much modified and surrounded by papillae. The above characters sharply distinguish the new species from others thus far known. By the two large branches of the spermatheca at its anterior end, *P. multiporus* is related to a group which includes *P. chaloneri* and its allied forms, discussed in an earlier part of the paper, but is sufficiently distinguished from any of them by the above-mentioned characters.

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BEES IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM—3.[1]

By T. D. A. Cockerell.

Of the University of Colorado, Boulder.

Having spent some weeks in Washington, arranging the exotic bees in the National Museum, I found it necessary to set aside a large number of undetermined species for further study. The neotropical fauna especially is represented by large collections which prove to contain many new and little-known species. The museum at the time of my visit contained about 460 determined species from south of the Mexican boundary (including the West Indies), but when the undetermined material has all been classified the number will probably be not less than 700. Various parts of the Old World are also represented by collections which add considerably to our knowledge of distribution and include forms new to science.

The present part includes the neotropical social bees of the genus *Melipona.* These insects, as also the species of the allied genus *Trigona*, present a great number of races or very closely allied species, as do the ants. The group of *Melipona fasciata*, for example, with its local forms in Brazil, British Guiana, Trinidad, Panama, Costa Rica, etc., recalls the condition found among the ants of such a genus as *Camponotus.* The several forms are also related to one another in much the same degree as the "representative species" in the islands of an archipelago, as the birds of the Galapagos Islands or the Lesser Antilles. The natural inference is that this production of numerous closely allied forms is not due primarily to anything peculiar about the variability of social bees or ants, but comes about as a by-product of isolation. It appears probable that the mating sexes of these insects almost always come from the same nest, so that the several colonies give rise to others through a process of inbreeding. The tendency under these circumstances is toward a homozygous condition, which is maintained until an accidental cross with another group occurs. It must be stated, however, that one form of dichroism appears to prevail within the limits of the colonies. The black and red variegation of the legs, which gave rise in one species to the name *M. variegatipes*, seems always to vary to a condition (probably recessive) in which the black pattern is absent. Owing to the existence of so many closely allied forms, the interpretation of many of the published descriptions, often without the citation of any exact locality, becomes very difficult. The United States National Museum possesses a large collection of these bees received from Dr. H. Friese, and I have followed his determinations whenever there was no reason to the contrary. In a few cases I have been obliged to dissent, and have given my reasons for so doing.

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[1] For previous papers in this series see Proc. U. S. Nat. Mus., vol. 39, 1911, pp. 635–658, and vol. 40, 1911, pp. 241–264.

XYLOCOPA FORMOSA Smith.

A female about 22 mm. long, from Mexico, D. F. (J. R. Inda, No. 52), appears to be large for this species, but it otherwise agrees, especially in the striking characters of the head described by Maidl. Is it possible that *X. loripes* Smith is the male of this species?

XYLOCOPA VIRESCENS Lepeletier.

Alhajuelo, Canal Zone, May 29, 1912 (Busck). This is a species of the *X. brasilianorum* group, remarkable for its large size and green wings. It agrees exactly with Lepeletier's measurement, and although cited by Maidl as a synonym of *brasilianorum*, I believe it is a perfectly valid species. There are three large black species with similar green wings, separable thus:

Disk of first abdominal segment with only feeble widely scattered punctures; anterior wing about 24 mm. long--------------------*callichlora* (Cockerell).
Disk of first abdominal segment strongly and quite closely punctured------ 1.
Third antennal joint longer; margin of scutellum before the truncation rounded; anterior wing about 23 mm. long------------- *virescens* Lepeletier.
Third antennal joint shorter; margin of scutellum before the truncation rather sharp; anterior wing about 19 mm. long-----------------*transitoria* Pérez.

Maidl also regards *transitoria* as a synonym of *brasilianorum*.

XYLOCOPA ARIZONENSIS Cresson.

Tlahualilo, Durango, Mexico, two males at flowers of peach (A. W. Morrill).

XYLOCOPA SPLENDIDULA Lepeletier.

Carcarana, Argentina (L. Bruner, No. 27).

XYLOCOPA CILIATA Burmeister.

Carcarana, Argentina (L. Bruner, Nos. 26 and 28.). The female oks like *X. colona* Lepeletier, but is readily separated by the densely unctured clypeus.

XYLOCOPA VIRIDIS Smith.

Alhajuelo, Panama (Canal Zone), March 7 and 12, 1912 (Busck).

XYLOCOPA VARIANS ECUADORICA Cockerell.

Alhajuelo, Canal Zone, May 28, 1912 (Busck). A male, differing from the female only in the usual sexual marks, and the abdomen having very distinct but narrow marginal white hair-bands at sides of segments 2 to 5. The cheeks have erect white hair, mixed with black above. Face narrow, orbits distinctly converging above; clypeus, supraclypeal mark, lateral face-marks, labrum, broad stripe on mandibles, front of scape, and narrow stripe on basal part of flagellum, all very pale yellowish; clypeus with scattered black hairs. The tegulae are dark, with a red spot in front and the outer margin red; in typical *varians* they are wholly red.

XYLOCOPA TABANIFORMIS Smith.

A male, Mexico (C. F. Baker collection, 2499). This has black tegulae; Smith, describing a female, says they are ferruginous. The face-marks agree with those of var. *chiriquiensis* Pérez, except that they are sulphur yellow.

XYLOCOPA RUFINA (Maidl).

Both sexes from Mexico (C. F. Baker collection, 2321). Maidl described this as a variety of *X. tabaniformis*, but I believe it to be distinct, since the abdomen of the male is broad like that of the female, and the orange-ferruginous hair on the abdomen is very distinctive. The male also has larger eyes than *tabaniformis*, and the hair on the cheeks is black. There are no lateral face-marks. Baker had labeled this "*tabaniformis?*".

XYLOCOPA RUFINA ILLOTA, new subspecies.

Female.—Length, 18 mm. Similar to *X. rufina*, with interrupted orange-fulvous bands on abdomen, but hair of head and thorax dark mouse-gray (that of cheeks gray, not black); process of labrum more slender; surface of clypeus perfectly dull (moderately shining in *rufina*); tegulae black.

Mexico (Baker collection, 2154).

Type.—Cat. No. 20699, U.S.N.M.

MESOTRICHIA CALENS MALAGASSA (Saussure).

Antanambe, Madagascar. Both sexes.

MESOTRICHIA ALBICEPS (Fabricius).

Mount Coffee, Liberia (R. P. Currie). Agrees with one from F. Smith's collection, labeled Gambia.

MESOTRICHIA GABONICA (Gribodo).

Mount Coffee, Liberia, April, 1897 (R. P. Currie). A male, very like *M. anicula* (Vachal), but distinguished by the structure of the hind legs.

MESOTRICHIA STUHLMANNI ALTICOLA, new subspecies.

Female.—Length about 16 mm.; anterior wing 13.5 mm. Wings very dark, not noticeably pale at base; face covered with silvery-white hair, which extends far up on sides of front; dorsum of thorax posterior to level of wings, and whole of dorsal surface of first abdominal segment, covered with bright yellow hair; mesopleura with black hair; tegulae with a large ferruginous spot on outer side. Male with flagellum red beneath; thorax above covered with yellow hair; yellow hair of abdomen beyond first segment sparse; wings paler than in female.

Mount Kilimanjaro, 2 females, 3 males (W. L. Abbott).

The specimens have been in alcohol, and can not be very satisfactorily described, but the yellow on the first abdominal segment will distinguish the insect from true *M. stuhlmanni* (Kohl). The female is smaller than *M. divisa* (Klug), and differs not only in the pubescence, but also in the more delicate punctures of the abdomen.

Type.—Cat. No. 20700, U.S.N.M.

This is very possibly a distinct species; it is probably the same insect which Sjöstedt collected on Kilimanjaro, which Friese recorded as *Xylocopa caffrariae*, var *capensis* Enderlein. The name *capensis* is preoccupied in *Xylocopa*, and I am confident that our insect is not the same as Enderlein's which came from " Capland " and Port Natal. *M. stuhlmanni* is also recorded from Kilimanjaro.

XYLOCOPA BAROMBIANA (Strand).

Mount Kenia to Fort Hall, British E. Africa, altitude 8,500 feet (E. A. Mearns). Both sexes. Described by Strand as a variety of *X. carinata* Smith, from which it differs in the male by having the thorax light-haired only anteriorly above, and on anterior part of mesopleura (in the manner of the form *producta* Smith), and the wings dark as in the female, not light at base. The hind femora and trochanters are both dentate. Strand's type came from Barombi Station in the Cameroons, but it appears to be entirely the same insect, except that ours have an imperfect narrow smooth line on the clypeus, which was absent from Strand's example. The female is almost exactly like *X. carinata*, but the region just above the top of the eyes is less densely punctured, showing the shining surface, and the smooth band on each side of the clypeus is much narrower and less developed. *X. carinata* is represented by a series of forms in different parts of Africa, and these may deserve only subspecific rank, but it seems probable that we may recognize several closely allied but distinct species.

MESOTRICHIA TENUISCAPA (Westwood).

Buitenzorg, Java, March, 1909 (Bryant and Palmer). Described by Westwood under the subgenus *Platynopoda* of *Xylocopa*, but referable to *Mesotrichia* in the broad sense.

XYLOCOPA FENESTRATA (Fabricius).

Chikar Kot, North West Provinces, India, April 1, 1906 (Frank Benton); Wazerabad, Punjab, April, 1906 (F. Benton).

XYLOCOPA COLLARIS, variety BRYANTI, new variety.

Male.—Length 19 mm. Agreeing with *X. collaris* Lepeletier in structure and appearance, but wings darker; a good deal of black hair on front; middle tibiae with black hair posteriorly, and their tarsi with long black hair externally and behind, except on the last three joints; hind tibiae with the hair on inner and posterior surfaces all black, and their tarsi with black hair, except a very little pale at base in front. The wings have a beautiful violet tint.

Buitenzorg, Java, April, 1909 (Bryant and Palmer).

Type.—Cat. No. 20701, U.S.N.M.

Lepeletier described *X. dejeanii*, now referred by authors to *collaris*, from a male in the Dejean collection said to come from Java. It agrees with the present insect in having the hair of the thorax pale (though in *bryanti* there is a band of black hair along extreme base of scutellum), and the pale hair of abdomen above confined to the first two segments (though in *bryanti* it fails to reach the apical margin of second segment in the middle third). On the other hand, the base of mandible has only a yellow spot, as in other *collaris* forms (Lepeletier may be misleading where he seems to infer more), the tegument of the thorax is distinctly greenish (Lepeletier says black, as in the Indian form *binghami* Cockerell), the long hair fringing apical part of abdomen is all black (Lepeletier says red and black mixed), and the hair on four posterior legs is as described above, the black fringe abruptly separated from the white on middle tarsi (Lepeletier says white, mixed with black hairs). It is thus evident that our insect is not the true *dejeanii*, but whether it is a distinct subspecies (as seems probable) can not now be decided.

XYLOCOPA PICTIFRONS Smith.

Male.—Soochow, China (N. Gist Gee, 141). The scape is curved and entirely black. This is Smith's male *pictifrons;* Bingham's is, according to Maidl, *X. attenuata* Pérez.

XYLOCOPA BENTONI, new species.

Male.—Length 18–20 mm. Black, the abdomen with a very obscure bluish tint; clypeus, supraclypeal mark, broad lateral marks reaching to level of lateral ocelli (at upper end a little divergent from orbit), transverse mark on labrum, and minute dot on base of mandibles, all ivory color; antennae black, third joint a little longer than following three united; inner orbits parallel, the front as broad as face; head and thorax with very pale ochreous hair, face with scattered brown hairs, middle of front and region of ocelli with much black or dark fuscous hair; sides of metathorax with some dark hair; legs with brownish-black and pale hair; anterior tibiae and tarsi fringed with long pale hair behind, but with dark hair in front; middle legs with more black hair, that on tarsi all dark, except some long glistening light hair on outer side above; hair of hind legs much like that of middle pair, but mainly dark on middle of tibiae posteriorly; hind femora beneath with much branched black hair; hind femora broad, angulate beneath basally; hind tibiae with inner face flat, apex on outer side with a snout-like projection; tegulae black; wings rather dilute brown, with delicate rosy tints in the apical field; abdomen with long and loose very pale ochreous hair on first three segments, on the third mixed with black; the remaining segments with very long loose black hair.

Abottabad, North West Provinces, India, April, 1906 (Frank Benton). Two males.

This insect looks superficially exactly like the common *X. collaris binghami* Cockerell, and has probably been overlooked on this account. It is very distinct in many important characters; the parallel orbits, shorter labial palpi, much shorter black scape, smaller ocelli, much greater distance between antennae and middle ocellus, smooth practically impunctate tegulae, shorter (triangular rather than cuneiform) second submarginal cell, more sparsely punctured abdomen with long loose hair, and the structure of the hind legs.

Type.—Cat. No. 20702, U.S.N.M.

XYLOCOPA APPENDICULATA Smith.

Male.—Length about 24 mm., anterior wing 20 mm. Black, the thorax densely covered with canary yellow hair, the first abdominal segment more thinly covered with the same, the rest of the abdomen appearing nearly bare, with fine black hair, the copious apical fringe brownish-black. Eyes extremely large, the orbits converging above and the large ocelli low down (style of *collaris*); clypeus, broad band-like supraclypeal mark, and spot at base of mandibles, yellow, but labrum and sides of face black; labrum without prominent tubercles; hair of head mostly black, but yellow on vertex, about mouth, and a little on middle of face; wings narrower and more pointed than in *X. sinensis* Smith, and uniformly fuscous; mesothorax with very much finer punctures than in *sinensis;* tarsi with a good deal of red hair.

Soochow, China (N. Gist Gee, 143).

Superficially very like *X. sinensis* Smith, but structurally very distinct. Smith's original (1852) description of the male leaves one doubtful, but his later (1874) one is sufficiently convincing, though lacking in detail. The above brief account will make recognition easier. Pérez (1901) gives fuller details and especially describes the structure of the hind legs.

XYLOCOPA SONORINA Smith.

Buitenzorg, Java, March, 1909 (Bryant and Palmer). One female of this little-known species.

The middle ocellus is situated in a V-shaped basin; the clypeus has broad smooth swollen borders, and near the apical margin a pair of opaque black spots emitting hairs; labrum trituberculate; wings only moderately dark, greenish tending toward brassy, coppery at apex. This is a true *Xylocopa*, not a *Mesotrichia.*

CERATINA CONGOENSIS Meunier.

Male.—Mount Coffee, Liberia. April, 1897 (R. P. Currie).

CERATINA CLADURA, new species.

Female.—Length about 8 mm. Shining black, with creamy-white markings; abdomen very boardly clavate, narrowed basally. Head rather large, the cream-colored portions being a very broad reversed T covering nearly all of clypeus, supraclypeal band (separated by narrow line from light color of clypeus), broad lateral face-marks (narrowing above, but reaching beyond middle of front), a pair of oblique marks on middle of front, small spots on labrum and base of mandibles, broad bands on cheeks, and a small spot on each side of vertex; middle of clypeus polished and wholly impunctate; antennae dark, scape ferruginous at extreme base; mesothorax dull and rough in front, otherwise very smooth and polished; light marks of thorax consisting of broad band on prothorax above, tubercles, broad but short bands above tegulae, two very obscure lines on disk of mesothorax, large patch covering most of anterior part of mesopleura, elongated patch beneath wings, scutellum, postscutellum, and a pair of very large patches on metathorax; at sides of prothorax is a reddish patch (perhaps originally yellow); area of metathorax black, obscurely transversely wrinkled, and with a rudimentary (basal) keel; tegulae testaceous; wings strongly dusky; stigma very long, dark brown; nervures fuscous, second submarginal cell comparatively small, subtriangular; legs black basally, anterior and middle femora broadly cream color at end, the tibiae of the same legs cream color with a reddish tint, the tarsi fuscous, ferruginous at end; hind legs without the creamy markings, tibial scopa long and loose; abdomen with a broad white band on first segment, straight behind, but broadly excavated in front; second and third segments with the base white, remaining segments black, hind margin of third obscurely reddened.

Buitenzorg, Java, March, 1909 (Bryant and Palmer). A remarkable species, allied to *C. benguetensis* Cockerell, from the Philippine Islands, but distinguished by the creamy-white markings and other characters.

Type.—Cat. No. 20703, U.S.N.M.

The four new species of *Ceratina* from Java now before me may be separated thus:

Abdomen clavate, light markings creamy-white------------*cladura*, new species.
Abdomen ordinary, not clavate; light markings yellow; scape black, not marked with yellow (males)-- 1
1. Apical plate of abdomen broadly rounded, without a central point; sixth segment with a large yellow mark----------*obtusicauda*, new species.
Apical plate with a conspicuous median point------------------------ 2
2. More robust; sixth segment with a large yellow mark--*acuticauda*, new species.
Less robust; sixth segment entirely black--------------*bryanti*, new species.

These are all quite distinct from the Indian *C. hieroglyphica* Smith, which Friese records from Buitenzorg. They are also readily distinguished from the allied Philippine Islands species. The dark scape is characteristic of the Java forms.

CERATINA OBTUSICAUDA, new species.

Male.—Length a little over 7 mm. Black, with bright lemon yellow ornaments, as follows: Clypeus (except margins, the black margin rather broad above, and at sides of upper part), transverse supraclypeal mark (broadly angulate above), narrow lateral face-marks (becoming linear above, and ending a little above level of antennae), large quadrate spot on labrum, narrow band on cheeks, narrow band on prothorax above, upper margin and broad apical part of tubercles, scutellum, apex of anterior femora (apical half beneath), all the tibiae on outer side, band (inclosing a spot on each side) on first abdominal segment, bands on second to fourth segments (on second very narrow except at sides, where it is abruptly enlarged and notched, on third also abruptly enlarged at sides but not notched), sixth segment with a large semilunar patch. Middle of clypeus with a distinct keel; antennae dark; mesothorax distinctly and quite closely punctured anteriorly, smooth and polished in middle, dull and rough along posterior margin; mesopleura densely punctured, with a shining spot above; tegulae rufous; wings strongly dusky, stigma and nervures dark, second submarginal cell large; abdomen very broad; apical plate very broadly rounded.

Pelaboean, Ratoe, Java (Bryant and Palmer).

Type.—Cat. No. 20704, U.S.N.M.

CERATINA ACUTICAUDA, new species.

Male.—Length about 7 mm. Black, with yellow markings; abdomen very broad. Very close to *C. obtusicauda*, but differing thus: Front with two yellow spots; hind tibiae with only basal half yellow behind; bands on third and fourth abdominal segments interrupted; apical plate with a conspicuous median point, and subangulate laterally. There are slight differences in the punctures of head and thorax hard to describe; thus the mesothorax posteriorly, instead of having an abruptly defined perfectly opaque band, has a broader one, visibly consisting of punctures, which gradually thin out anteriorly.

The difference in structure between the two species, as regards the end of the abdomen, is like that between the American *C. dupla* and *C. mexicana*, except that *acuticauda* has not salient lateral angles like those of *mexicana*. There are four short yellow stripes on mesothorax.

Buitenzorg, Java, April, 1909 (Bryant and Palmer).

Type.—Cat. No. 20705, U.S.N.M.

CERATINA BRYANTI, new species.

Male.—Length 7 mm. Black, with lemon yellow markings. Close to *C. acuticauda*, but less robust, and also differing thus: Upper arm of clypeal mark abbreviated, so that there is a considerable distance between it and the supraclypeal band; mesothorax with only the outer yellow stripes, and these reduced; wings nearly clear (not brown as in *C. acuticauda*); anterior femora with a yellow spot not connecting with the apex; middle tibiae black except for a basal spot; hind tibiae with basal three-fifths yellow on outer side; first and sixth abdominal segments entirely black; second and third segments with lateral marks only, fourth and fifth with entire bands; lateral angles of apical plate more prominent.

Pelaboean, Ratoe, Java (Bryant and Palmer).

Type.—No. 20706, U.S.N.M.

CERATINA VOLITANS Schrottky.

San Bernardino, Paraguay, October 25 (K. Fiebrig).

CERATINA CHRYSOCEPHALA Cockerell.

Manaos, Brazil (Miss H. B. Merrill). This is the type-locality.

CERATINA PUNCTULATA Spinola.

Near Para, Brazil (Miss H. B. Merrill). Compared with a Panama specimen from F. Smith's collection, this differs (female) in having a yellow stripe on anterior tibiae, middle of mesothorax rosy-purple, and abdomen with strong coppery tints. Possibly a valid subspecies is indicated. The insect is closely allied to the larger *C. chrysocephala.*

CERATINA AMABILIS Cockerell.

S. Lucrecia, Vera Cruz, Mexico (Crawford). From the same place is a specimen of the similarly colored *Augochlora ignita* Smith.

CERATINA MORRENSIS Strand.

Females.—San Bernardino, Paraguay (K. Fiebrig). One is marked November 1, at flowers of *Zea mays.* The three specimens before me have the dimensions of Strand's variety *cuprifrons;* the abdomen varies from brassy-green to blue-green and almost black. The strong violet tints, especially about the head, are very beautiful. This is closely allied to *C. cupreiventris* Smith from Ega, which Ducke has proposed to treat as a synonym of *C. maculifrons* Smith, but the latter is constantly much smaller and so far as I know always readily separable.

CERATINA VIRIDULA Smith.

Female.—Paraiso, Canal Zone, Panama, February 8, 1911 (Busck). Smith describes only the male; the female is like a small *C. laeta* Spinola, but there is a transverse white spot on the black apical margin of clypeus. Ducke makes this species a synonym of *C. laeta,* but I consider it quite distinct.

CERATINA BUSCKI, new species.

Male.—Length nearly 4.5 mm. Head and thorax brilliant golden green; abdomen blackish marked with yellowish-green, the first four segments each having a green band, most distinct and brilliant on the second; clypeus (except upper lateral margins, which are green and have very large punctures), small cuneiform lateral face-marks, labrum (except a dusky dot on each side) and very large mark on base of mandibles, ivory-color; green parts of face with very large punctures; antennae long; scape short and black; flagellum dull ferruginous, darkened above; sculpture of thorax ordinary, area of metathorax granular; tegulae piceous; wings dusky, stigma and nervures fuscous; apical plate of abdomen with a broad but distinct apical angle, the sides rounded (style of *C. atrata* H. S. Smith, but the median angle much less salient); femora mainly green (anterior and middle ones black in front), tibiae and tarsi ferruginous.

Taboga Island, Panama, June 10, 1911 (August Busck). Also one from the same locality, Feb. 22, 1912 (Busck).

Related to such species as *C. lucidula* Smith, *C. muelleri* Friese (which Ducke thinks should not be separated from *lucidula*) and *C.*

minima Friese, but known by the brilliant green head and thorax, and the color of the legs.

Type.—Cat. No. 20707, U.S.N.M.

OSIRIS PANAMENSIS, new species.

Female.—Length about 7 mm., not counting exserted sting. Polished, shining ferruginous or rufo-testaceous; front, vertex (except obscure reddish mark above each eye) and mesothorax black; abdomen suffusedly dusky; hind tibiae, except at base, black, covered with black hair; hind basitarsi as broad as tibiae, dark reddish, covered with black hair; spurs of middle and hind legs large and dark; tegulae rufotestaceous; wings clear hyaline, orange tinted, apex grey; stigma and nervures pale ferruginous; second s. m. broad, receiving first recurrent nervure in middle; third submarginal cell narrower on marginal than on outer discoidal; antennae ferruginous, apical half of flagellum dusky above; third antennal joint much shorter than fourth. Prothorax above swollen on each side; area of metathorax very large, triangular, smooth, and polished, except a narrow transverse rugosoplicate band at base; claws simple, bulbous at base; tongue with broad spoon-like end; second joint of labial palpi about 608 μ long, the two last joints each about 80 μ long; maxillary palpi about (not over) 352 μ long; a delicate keel down middle of front; hind wing with seven costal hooks.

Taboga Island, Panama, June 10, 1911 (A. Busck).

Nearest to *O. tarsatus* Smith but easily known by the black on hind legs.

Type.—Cat. No. 20708, U.S.N.M.

RHATHYMUS BICOLOR, variety NIGRIPES Friese.

Female.—Toca do Onca, Brazil, June 27, 1915.

The legs have a good deal of pale hair, contrary to Friese's description, but there is otherwise excellent agreement. In color the insect resembles *Epicharis conica* Smith, but the wings are much darker.

RHATHYMUS UNICOLOR Smith.

Female.—Sapucay, Paraguay, April 7, 1903 (W. T. Foster).

The specimen is almost 20 mm. long, but otherwise agrees with *R. unicolor*. It looks like a large red *Nomada*.

OXAEA TACHYTIFORMIS Cameron.

Mexico, D. F. (J. R. Inda, No. 37). This agrees perfectly with one from Venta de Zopilote, Guerrero, 2,800 feet, October (H. H. Smith), which Mr. Meade-Waldo compared with Cameron's type. The locality assigned by Cameron, "Santa Fé Mountains, New Mexico," was, of course, entirely erroneous. The flagellum is truncated in such a way that it appears as if broken off.

PROTOXAEA IMPUNCTATA, new species.

Female.—Length, 20 mm. Almost exactly like *P. texana* Friese, with bright rufofulvous hair on thorax above, and abdomen largely green, but differing thus; wings, although smoky, considerably paler; occiput, cheeks, sides of face, and region of ocelli with light fulvous hair; anterior femora with long pale hair; hair of middle of metathorax and middle of extreme base of abdomen creamy-white, contrasting with the red hair all around; dorsal surface of abdomen impunctate, except at sides, where it is sparsely punctured.

This cannot be the female of *Oxaea tristis* Gribodo; in *tristis* the second recurrent nervure joins the third submarginal cell very little beyond the middle, in *P. impunctata* near the beginning of the last third.

Mexico, D. F. (J. R. Inda, No. 55).

Type.—Cat. No. 20709, U.S.N.M.

PTILOGLOSSA MEXICANA Cresson.

Male.—Taboga Island, Panama, June 12, 1911 (A. Busck). Resembles *P. eximia* Smith, but mesopleura with black hair. The labrum and clypeus are honey color; scape honey-color in front; anterior legs with long clear red hair; hair at end of abdomen grayish-black. Cresson described only the female, which I have from Guatemala. I believe the Panama insect to be its male, although it is evidently not the insect described by Friese as male *mexicana.* The matter will have to remain a little uncertain until we have both sexes from Panama.

PTILOGLOSSA CRAWFORDI, new species.

Male.—Length about 19 mm. Robust, black, quite without any metallic tint; head and thorax densely covered with black hair; disk of clypeus with long appressed white hair; a transverse band of dull white hair above the clypeus, extending downward at sides halfway to mandibles; hair of cheeks and under side of body greyish or dilute black; clypeus prominent, quadrate, with flattened disk; eyes converging above; antennae black, flagellum pruinose beneath; third antennal joint much longer than next three together; tegulae black; wings strongly fuliginous, shining purple; first recurrent nervure practically meeting first transverso-cubital, or joining first submarginal cell some distance from its end; legs black, with black hair, small joints of tarsi reddish; abdomen with white hair at extreme base, and ferruginous hair at apex, but otherwise with rather thin black hair; venter with long pale hair, white basally, ferruginous apically, and in the middle suffusedly blackish.

Ujurass de Terraba, Costa Rica, September 1, 1907, 3 males (M. A. Carriker).

Type.—Cat. No. 20710, U.S.N.M.

Named after Mr. J. C. Crawford in recognition of his work on the bees of Costa Rica, and of the fact that he had separated the species as new before I saw it. *P. crawfordi* is a very distinct and unique species, easily known by its color and the long third antennal joint. The spurs of the hind legs are quite ordinary, not modified as in *P. ollantayi* Cockerell, *P. matutina* Schrottky, and *P. mexicana* Cresson. The insect is not a typical *Ptilgolossa*, but it falls in that genus better than elsewhere. A pecular feature of the venation is the thickening and strong arching of the radial nervure before the apex of second submarginal cell, with the result of making the base of the marginal cell acutely pointed. This is merely an exaggeration of the condition found in other species of *Ptiloglossa*. In *Caupolicana* the condition is still more extreme, so that the base of the cell appears obliquely truncate. The genera *Ptiloglossa* and *Caupolicana* are so closely allied that it is doubtful whether they should be kept apart.

The female of the Chilean *Caupolicana fulvicollis* Spinola has the hair of thorax and first abdominal segment a very rich deep orange-ferruginous, while the male has pubescence like that of *C. gayi* Spinola. The United States National Museum has both sexes collected by M. J. Rivera at Constitucion, Chili, October 20, 1906. The specimen of *C. gayi* in the museum comes from Maipu, Chili (F. V. Ibarro).

TRIEPEOLUS FOXII, new species.

Female.—Length 9 mm. Similar to *T. vicinus* (*Epeolus vicinus* Cresson), but with perfectly entire bands on abdominal segments 2 to 4, and the oblique patches on sides of second segment separated from the band. On the first segment the apical interruption of the fulvous is rather narrower than the basal.

Portland, Jamaica, 2 females.

Type.—Cat. No. 20711, U.S.N.M.

This is doubtless the insect recorded by Fox from Port Antonio as *E. vicinus*. The characters might be considered varietal only, but the Jamaican insect presumably represents a form peculiar to that island.

TRIEPEOLUS (WILSONI variety?) BUSCKI, new species.

Female.—Length 13 mm., agreeing with *T. wilsoni* (*Epeolus wilsoni* Cresson), which is only known in the male, except that the antennae and legs are clear ferruginous, the head is entirely clear ferruginous, thorax dark ferruginous with the metathorax black, apical margin of wings not much darker than the rest; ground color of abdomen dark ferruginous, black on disk and sides of base of first segment. The specimen is perfectly mature, indeed somewhat worn.

Baracoa, Cuba, August, 1902 (A. Busck).

Type.—Cat. No. 20712, U.S.N.M.

This is very probably a red variety of *T. wilsoni*, but it seems to deserve a distinctive name. I have no specimens of *wilsoni* to compare; possibly they would show structural differences. The light orange-fulvous markings of the abdomen are very bright and beautiful.

NOMADA AZTECORUM PRATENSIS, new subspecies.

Female.—Length 10.5–11.5 mm. Differs from the typical form as follows: Legs (except coxae) bright ferruginous, the hind femora suffused with blackish behind; yellow area of clypeus triangular; lateral face-marks more extended above, but variable; cheeks red or with a red band behind eyes; mandibles ferruginous, blackish apically; labrum ferruginous; mesothorax with two broad dull red bands, or these absent; spots on metathorax red; yellow band on first abdominal segment widely interrupted; venter with variably developed yellow bands, on fifth segment a yellow spot on each side.

Allotype—Male.—Length, 10–12.5 mm. Similar to the female, but with the following sexual characters: Face yellow, except a black line bounding clypeus and supraclypeal mark; labrum and large spot on mandibles yellow; red band on cheeks narrow or nearly obsolete; scape greatly swollen, punctured, black, red at base and at apex on outer side; third antennal joint conspicuously longer than fourth; tegulae with a rather obscure yellow spot; femora marked with black near base and with variable yellow stripes, which may be obsolete; apical plate of abdomen entire or very faintly notched, its surface often marked with yellow.

Meadow Valley, Mexico, 2 females, 5 males, collected by C. H. T. Townsend.

Type.—Cat. No. 20713, U.S.N.M.

This seems to be a subspecies rather than an individual variety; the locality is far north of that (Amecameca) of typical *N. aztecorum* Cockerell.

NOMADA HEILIGBRODTI Cresson.

Both sexes from Cypress Mills, Texas, from the Ashmead collection. The male described by Cresson does not belong to this species; the true male has yellowish-white markings, face all light below antennae, apical plate of abdomen notched. The abdomen of the male looks just like that of *N. scita* Cresson, but the antennae are entirely different. The metathorax is obscure reddish without spots. The densely and coarsely punctured mesothorax distinguishes this from the very similar *N. vierecki* Cockerell.

COELIOXYS (LIOTHYRAPIS) FENESTRATA Smith.

Soochow, China (N. Gist Gee); Hakone, Japan, August 15 (Sasaki No. 154). Both are females; the Japanese one has the last ventral segment distinctly more produced. The insect is larger than Smith's measurement would suggest, and he did not notice that the eyes were hairless. I have seen Smith's type.

COELIOXYS (LIOTHYRAPIS) DUCALIS Smith.

Mount Salak, Java, 3,000 feet, May 15, 1909 (Bryant & Palmer).

COELIOXYS HAKONENSIS, new species.

Female.—Length about 12 mm. Black, rather robust; eyes with rather short hair; inner orbits strongly converging below; mandibles black; face and front covered with light reddish-fulvous hair, dense except on clypeus, lower margin of clypeus with a dense fringe; clypeus rugosopunctate; cheeks keeled behind; antennae 5 mm. long, entirely black; occiput with light fulvous hair; mesothorax with very large confluent punctures, and scutellum even more coarsely sculptured, irregularly cancellate; hair of thorax pale fulvous or ochreous, becoming white below; axillar spines large, curved; hind margin of scutellum very obtusely angulate, the apex turned upward; tegulae bright chestnut red; wings dilute brown, paler basally; legs black, spurs ferruginous; anterior coxae with prominent angles, not amounting to spines; abdomen shining with large punctures, widely separated on disk of second segment, a little closer on third, closer and smaller on fourth and fifth; sixth dorsal segment rather broad, closely and finely punctured, conspicuously keeled (style of *C. penetatrix* Smith, but broader apically; last ventral segment extending a moderate distance beyond last dorsal, broad, acutely pointed, not notched at sides; dorsal segments with entire pale fulvous hairbands; hind margins of ventral segments rufous.

Hakone, Japan, Aug. 15 (Sasaki 150).

Type.—Cat. No. 20714, U.S.N.M.

Resembles *C. fulviceps* Friese, from Formosa and China, but readily known by the red tegulae and last ventral segment not notched at sides, but only slightly narrowed at the point where the notch occurs in other species. It is also to be compared with *C. suisharyonis* Strand, from Formosa, but the end of the abdomen is quite different.

COELIOXYS LITORALIS Holmberg.

Female.—Mendoza, Argentine (C. S. Reed). This runs exactly to *litoralis* in the tables of Holmberg and Friese, but Jörgensen does not cite the species from Mendoza. The identification needs confirmation by actual comparison of specimens.

GRONOCERAS FELINA (Gerstaecker).

Female.—Mount Kenia to Fort Hall, British East Africa, 8,500 feet (E. A. Mearns).

MEGACHILE DOEDERLEINII Friese.

Kuling, Kiangsi, China (N. Gist Gee 51a).

OSMIA (PACHYOSMIA) PEDICORNIS, new species.

Female.—Length nearly 15 mm. Robust, hairy, obscure green; head large, with broad cheeks and vertex; middle of face with very long outstanding reddish hair; sides of face and lower part of front with long dull white hair, slightly creamy; upper part of front with thin black hair; cheeks and upper part of head behind with long white hair; mandibles broad and long, with two teeth; clypeus excavated in middle, forming a smooth basin, lower margin strongly bidentate, sides with enormous horns shaped like a boot, the toe turned inward and downward; antennae black, scape long; mesothorax finely and very densely punctured; hair of thorax long and erect, rather dull white, on scutellum slightly stained with brown; tegulae rufopiceous; wings greyish, a fuliginous streak in marginal cell; second submarginal cell very long; legs black, hair of tarsi mainly ferruginous; abdomen broad, shining, with long white hair on first segment and base of second; on third the hair is dark brown, on fourth and fifth black; ventral scopa orange.

Soochow, China (N. Gist Gee 125).

Type.—Cat. No. 20715, U.S.N.M.

A distinct and remarkable species, allied to the European *O. cornuta* (Latreille), but the abdomen is less densely hairy, the pubescence is quite differently colored, and the clypeal processes are differently shaped.

A male from the same locality (N. Gist Gee. No. 126) is referred here with confidence. It is about 12 mm. long, narrower than the female, and runs in Friese's table of Palaearctic species next to *O. rufa*, from which it is quite distinct. Clypeus simple; antennae long, reaching to end of thorax, entirely dark; hair of face and front long, creamy white, but black hair in region of ocelli; abdomen with black hair on fourth and fifth segments; six segment with reddish hair and entire margin; margin of fourth ventral segment broadly truncate in middle; tarsi with apical joint red. The long maxillary blade has a dark longitudinal band as in *O. rufa.*

OSMIA AZTECA Cresson.

Cresson only described the female. The male (Mexico, Baker collection 2386, and one labeled Mexico, without further data) is about 11 mm. long; hair of face pale ochreous; antennae long, entirely black; hair of thorax above orange-fulvous, but white on mesopleura; area of metathorax dull; abdominal segments 3 to 5 with the red fringes very bright and glistening; sixth segment truncate (faintly emarginate) in middle; seventh strongly bidentate.

ANTHOPHORA ACERVORUM, variety SQUALENS Dours.

Soochow, China (N. Gist Gee, males No. 123, females No. 124). I thought at first to separate the Chinese form as a distinct variety; but after examining specimens of four different European varieties there seemed to be no advantage in attempting to define another, though the Chinese specimens are slightly different from the available European ones. The males have a large yellow spot on mandibles, and the middle tarsi have joints 2 to 4, and base of 5, red.

ANTHOPHORA VIGILANS Smith.

Buitenzorg, Java, March, 1909 (Bryant and Palmer); Tjibodas, Mount Gede, Java, April 20, 1909 (Bryant and Palmer); Mount Salak, Java, 2,500 feet, March 7, 1909 (Bryant and Palmer). The male has very large foot-shaped black marks on clypeus.

ANTHOPHORA TEXANA Cresson.

Mexico, D. F. (J. R. Inda 39); Mexico (Baker coll. 2320).

CROCISA DECORA Smith.

Buitenzorg, Java, March (Bryant and Palmer); Depok, Java (Bryant and Palmer); Mount Salak, Java, above 3,000 feet, May 4, 1909 (Bryant and Palmer). The Depok one has the markings pale greenish blue, a different tint from that of the others, but it seems to represent only an individual variation.

CROCISA JAPONICA Friese.

Kuling, Kiangsi, China (N. Gist Gee). This is perhaps racially separable from the Japanese insect, but I do not venture at present to describe it as distinct. It is very close to *C. kanshireana* Cockerell from Formosa, but is easily separated by the blue spots on the lobes of the scutellum. It is distinct from *C. surda* Cockerell.

CROCISA IRISANA HUMILIS, new subspecies.

Buitenzorg, Java, March and April (Bryant and Palmer); Pelaboean, Ratoe, Java (Bryant and Palmer).

Type.—Cat. No. 20716, U.S.N.M.

Length of female, 9 mm.

Typical *C. irisana* is from the Philippine Islands; the Javan form has very dark wings, the tarsi with hardly any pale hair, and the scutellar notch with very little or no pale hair above. The type-locality of the subspecies is Buitenzorg. It is a rather poorly defined form, but four specimens are before me and seem to indicate that the Javan insect is recognizably distinct. Friese records this from Java as *C. pulchella* Guérin, but the original *pulchella* (never properly described) came from New Ireland and was supposed to be a variety of *C. nitidula* Fabricius.

CROCISA LILACINA, new species.

Male.—Length about 12 mm. Robust, with blue markings; clypeus prominent, finely punctured; sides of face (extending halfway up front), supraclypeal area and upper and lateral margins of clypeus all covered with blue hair; cheeks with blue hair; occiput with a fringe of hair, black in middle and white at sides; eyes greatly broadened below; mesothorax anteriorly with a pair of transverse bright blue patches, partly on prothorax; the usual four mesothoracic spots, short median band, and spots above tegulae, also blue, but the posterior spots nearly obsolete (rubbed off?); scutellum W-like, with rather sparse minute punctures, no light hair on disk, but a little white hair from beneath notch; tubercles fringed with reddish-fuscous hair; upper part of pleura with light blue hair, lower part with black, but nearly bare and strongly punctured; tegulae black with a large ferruginous mark; wings brown, with hyaline spaces; anterior and middle tibiae blue on outer side, but hind tibiae with only basal half blue; tarsi dark, without blue; markings of abdomen delicate lilac-blue, not metallic; first segment blue right across, the hind margin and a roof-shaped median mark black, this marking as in *C. caeruleifrons* Kirby, except that the blue is not interrupted basally; segments 2 to 5 with broad blue bands, rather widely interrupted in middle, sixth with some pale hair at sides; apex with two short teeth.

Buitenzorg, Java, March, 1909 (Bryant and Palmer).

Type.—Cat. No. 20717, U.S.N.M.

Resembles *C. caeruleifrons* Kirby, but differs by the blue at base of abdomen not interrupted; band on second segment more widely interrupted; hind tibiae with less blue, and general appearance less brilliant. It is much too large for *C. basalis* Friese and otherwise different.

CROCISA SORDIDA, new species.

Female.—Length about 11 mm.—Robust, with beautiful blue markings on head, thorax (except scutellum) and legs, but on abdomen and scutellum (large patches nearly covering lobes) they are gray and inconspicuous; there is a very little blue at extreme sides of abdomen. The hair is loose, not scale-like, and the blue is not metallic. Face and sides of front with light greenish-blue hair, sparse on disk of clypeus; cheeks and occiput with blue hair, but black behind ocelli, and partly near top of eyes; sides of vertex polished, with very sparse large punctures; thorax above with prothoracic band, long band on mesothorax (narrowing posteriorly), spot on each side of this band, band along mesothoracic margin from front of tegulae to near middle posteriorly, all bright blue; tegulae blue-spotted in front and behind; blue crescent behind tubercles; blue band across mesopleura and markings on under side of thorax; scutellum W-like, a very little light hair from beneath notch; wings very dark; outer side of anterior and middle tibiae, basal half of hind tibiae, and first two joints of tarsi, covered with bright blue hair; first abdominal segment covered with gray hair, except narrow hind margin; segments 2 to 5 with broad bands narrowly interrupted on 2, broadly on the others.

Soekaboemi, Java, March 25, 1909 (Bryant and Palmer).

Type.—Cat. No. 20718, U.S.N.M.

A remarkable species on account of the obscure abdominal markings. In the character of the markings it resembles *C. abdominalis* Friese, also from Java.

CROCISA CALCEATA Vachal.

Male.—Sierra Leone. A specimen from Vachal, labeled "*Crocisa*, sp.", evidently prior to the description of *calceata.*

Genus OEDISCELIS Philippi.

Philippi based this genus (1866) on two species, *O. minor* Philippi and *O. vernalis* Philippi; the latter is herewith designated as the type. In later years species have been described by Friese, Ducke, Schrottky, and Bréthes. Mr. J. C. Crawford has made the surprising discovery that Ashmead's genus *Hylaeosoma* (1898) is apparently identical with *Oediscelis. Hylaeosoma* was based on *H. longiceps* Ashmead, from St. Vincent, West Indies; and in 1906 a second species, *H. ashmeadi* Crawford, was described from Costa Rica. The type of *Oediscelis* is, unfortunately, not available, but the United States National Museum contains specimens of *O. albida* Friese, *O. styliventris* Friese, and *O. inermis* Friese. These species of *Oediscelis* are very like *Prosopis*, but more hairy. The cheeks and under side of abdomen of *O. styliventris* have long white hair, but the species of *Hylaeosoma* are very little hairy. The species of *Oediscelis* and *Hylaeosoma ashmeadi* female have white hair on under side of abdomen. The female *H. longiceps* is broken, so this character can not be made out, but the male lacks the white hair, wherein it does not differ materially from male *O. albida*, etc.

Comparing the males of *H. longiceps* and *O. albida*, they are similar in appearance, with the same long (oval) head and very long (high) middle lobe of clypeus, but *longiceps* has no light face marks. They agree in the strong median groove of mesothorax, and both have a large stigma. The venation presents important differences; *O. albida* has the second submarginal cell large and quadrate, with first recurrent nervure meeting first transverse cubital; *H. longiceps* has the second submarginal cell very small, with first recurrent nervure falling short of it by a distance nearly equal to width of second submarginal cell. In the *Hylaeosoma* the basal nervure falls short of transverse median a distance at least as great as length of transverse median, but a lesser distance in the *Oediscelis*. The females of the two species agree in having little hair on hind legs. *Hylaeosoma ashmeadi* female has second submarginal cell large, with first recurrent nervure falling only a little short of it, and basal nervure does not fall far short of transverse median.

O. styliventris male has long antennae, and first recurrent nervure falling short of second submarginal cell. *O. inermis* male has similar characters, but hind femora angled below. The face marks of male *inermis* and *styliventris* are very different.

It thus appears that *Oediscelis* contains quite diverse elements, and so far as external characters go it is difficult to separate it from *Hylaeosoma*. It has not been possible to compare the mouth parts or genitalia. Various generic names have already been proposed (*Pseudiscelis* for *O. rostrata* Friese, *Protodiscelis* for *O. fiebrigi* Bréthes, *Prosopoides* for *O. paradoxa* Ducke) for species of *Oediscalis* taken in the broad sense, and if all these bees are regarded as belonging to a single genus it will be hard to exclude *Hylaeosoma*.

Ducke cites *Chilicola* Spinola (1851) as doubtfully identical with *Oediscelis*. If the two are identical, *Chilieola* has priority. I have a pair of bees which I received as *Chilicola plebeja* Spinola, but they do not agree with Spinola's diagnosis of the genus, and are, in fact, Panurgids, closely allied (at least) to *Panurginus herbsti* Friese.

If *Hylaeosoma* is regarded as a subgenus of *Oediscelis* it will apparently be necessary to restrict it to the West Indian *H. longiceps*.

CENTRIS HAEMORRHOIDALIS (Fabricius).

St. Andrew, Jamaica, April 1898 (C. B. Taylor).

CENTRIS ELEGANS Smith.

Male.—Windward side, St. Vincent, West Indies (H. H. Smith). Smith described the female only. The male is like that of *C. haemorrhoidalis*, with the same face markings, but has the hair on and about the postscutellum reddish ochreous, the face markings (perhaps altered by cyanide) more decidedly yellow, the stripe on anterior tibiae reduced to two spots (representing the ends), the marks at sides of second abdominal segment transversely elongate, the apex of abdomen not red, and the hair on hind basitarsus all black.

CENTRIS ELEGANS GRENADENSIS, new subspecies.

Male.—Grenada, West Indies (H. H. Smith). Differs from the St. Vincent form thus: Face marks creamy white; stripe on anterior tibiae well developed, except basally, where it fails except for a basal spot; scutellum ferruginous; much fulvo-ochraceous hair behind wings; tegulae ferruginous; hair on hind tibiae and tarsi dark reddish; abdomen red at extreme tip. Some of these characters may be individual, but we doubtless have a distinct insular form.

Type.—Cat. No. 21648, U.S.N.M.

CENTRIS MURALIS Burmeister.

Male.—San Juan, Argentina (C. S. Reed). Male (var. *melanopus* Friese) and female. Mendoza, Argentina (C. S. Reed).

CENTRIS HOFFMANNSEGGIAE Cockerell.

Female.—Claremont, California (Baker).

CENTRIS COCKERELLI Fox.

Female.—San José de Guaymas, Mexico, April 10 (L. O. Howard).

CENTRIS NITIDA GEMINATA Cockerell.

Female.—Chauchamayo, Peru (F. W. H. Rosenberg). Superficially looks exactly like *C. nigriventris* Burmeister, but is quite distinct. New to Peru.

Male.—Guayaquil, Ecuador. Light band across clypeus entire; end of abdomen covered with silvery white hair; hind trochanters dentate; hind basitarsi with a spine; scape entirely black.

CENTRIS CALLOXANTHA, new species.

Male.—Length about 15 mm., anterior wing 13; black, with black hair, but whitish on cheeks, and brilliant canary yellow on thorax above and on tubercles, the disk of mesothorax posteriorly with a round fuscous patch; clypeus much broader than high, smooth, flattened on disk, ivory color, except the broad black upper and lateral margins; rest of head without light marks; eyes large, dark olive; antennae placed far apart, close to eyes; scape very short, entirely black; flagellum ferruginous beneath except basally; ocelli well down on front; mesothorax finely and extremely densely punctured; tegulae black; wings dark fuliginous, second submarginal cell as high as long; hind femora and tibiae extremely stout; hair of abdomen all black, including first segment. The long dense hair of hind tarsi is dark chocolate color.

Chauchamayo, Peru (F. W. Rosenberg). A remarkable species, related to *C. femoralis* Friese, *C. lutea* Friese, and *C. mexicana* Smith, but known by the light clypeus and black labrum.

Type.—Cat. No. 21649, U.S.N.M.

CENTRIS OBSCURIVENTRIS Friese.

Female.—Bocas del Toro, Panama, July, 1908 (W. Robinson).

Male.—Frontera, Tabasco, Mexico. This is the widely distributed form which Friese describes under *C. decolorata* Lepeletier, remarking that Lepeletier's description does not agree very well and suggesting *obscuriventris* as a substitute in case of doubt. It is the same species which I have recorded from Natal, Brazil, as *C. maculata* Lepeletier, but Lepeletier omits to notice any black hair on the legs of *maculata* or *versicolor*. It is very probable that Lepeletier's names were applied to the two sexes of the species before us, but since there are discrepancies in the descriptions, it seems better, for the present, to use the name suggested by Friese.

CENTRIS BIMACULATA Lepeletier.

Male.—El Rancho, Guatemala, January 20, 1905 (Chas. C. Deam).

CENTRIS BIMACULATA CARRIKERI, new subspecies.

Female.—Length 18 mm. Wings hyaline basally, about as far as basal nervure and including first brachial cell; beyond this very dark fuliginous; hair of thorax above creamy white.

Aroa, Venezuela, "on *Aster*," December 16, 1910 (M. A. Carriker). Looks very distinct on account of the coloration of the wings, but otherwise agrees with *C. bimaculata*.

Type.—Cat. No. 21650, U.S.N.M.

CENTRIS CHLORURA, new species.

Female.—Robust, about 20 mm. long, anterior wing 14.5; head, thorax, and legs black, abdomen clear green, the hind margins of segments concolorous; first two segments bluer, approaching steel-blue, the others yellowish green. Head with black hair, grayish between antennae, and more or less on lower part of cheeks; face entirely black; clypeus prominent, with large punctures; labrum large, strongly punctured; mandibles strongly tridentate; the teeth largely fulvous; antennae entirely dark, long for a female; thorax with dark gray hair, paler at sides, a tuft of pale ochreous hair behind wings; scutellum ordinary, covered with hair; tegulae black; wings fuliginous; second submarginal cell long, not much deformed; anterior and middle legs with black hair; hind tibiae and tarsi with very large clear fulvous scopa; middle basitarsus with a sharp ferruginous bare edge in front, its surface transversely corrugated; anterior basitarsus beneath with a brush of six long stout bristles, curled at end; anterior tibiae with an apical patch which appears pale or dark according to the angle of vision; claws of anterior and middle legs with a large inner tooth, but of hind legs slender, with the tooth extremely minute; abdomen covered with long fulvous hair, not banded, no black hair intermixed; apex fringed with bright copper-red hair; apical plate rather broad.

Piches and Perene Valleys, Peru, 2,000–3,000 feet (Geographical Society of Lima).

A remarkable species, nearest to *C. festiva* Smith and *C. semicaerulea* Smith, but known by the long hair covering the abdomen, the hind margins of abdominal segments not testaceous, and the dark wings.

Type.—Cat. No. 21651, U.S.N.M.

CENTRIS LINEOLATA Lepeletier.

"On Aster"; Rio Mato, Caura district, Venezuela (M. A. Carriker). The hair of the thorax above is bright fox red.

CENTRIS PACHYSOMA, new species.

Female.—Very robust, length, 23 mm.; anterior wing, 17.5; hair of thorax above dusky fulvous, paler posteriorly; tegument of thorax and abdomen (except extreme apex) wholly black. Mandibles largely yellow, strongly curved apically; labrum pale yellow, with a large pale brown spot; hair of labrum light golden, a long tuft at apex; clypeus with lower margin broadly rufous, inferior lateral areas very broadly yellow, the yellow interrupted in the middle line, disk with a longitudinal smooth raised yellow band; scape with a yellow stripe; anterior and middle knees with yellow spots; tegulae ferruginous; wings dark fuliginous; scopa of hind legs entirely black; hair of apical part of abdomen pale, beginning on middle of fourth segment, that at extreme apex red. The lateral face-marks are triangular (very broad cuneiform).

Palcazu, Peru (Rosenberg). I do not describe this in greater detail, since it agrees in all respects with the description of *C. lineolata* Lepeletier. I should have referred it to *lineolata* without any question, except for the fact that according to Friese the female of that species is only 18–19 mm. long, and the additional circumstance that I have been able to recognize as *lineolata* a different insect from Venezuela, the type locality being "Cayenne."

Type.—Cat. No. 21652, U.S.N.M.

CENTRIS FUSCIVENTRIS Mocsary, variety CAURENSIS, new variety.

Male.—Length about 22 mm. Clypeus with a pair of large quadrate yellow patches, their margins suffused; lateral face marks small and obscure, between clypeus and eye; hair of lower part of cheeks rusty black; tegulae black, with a large dull reddish spot; second abdominal segment with a dark red suffusion on disk; scopa of hind tibiae and tarsi, and hair covering hind knees, light fulvous; apical joints of tarsi mainly chestnut red. Scutellum shining and bigibbous.

Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker). Superficially this looks exactly like *Epicharis rustica* (Olivier), except that it is somewhat more robust.

Type.—Cat. No. 21653, U.S.N.M.

CENTRIS FUSCIVENTRIS, variety MATOENSIS, new variety.

Male.—Length about 23 mm., like variety *caurensis*, except as follows: Face-markings obsolete, their place indicated by a reddish suffusion; scopa on hind tarsi, on apical part of tibiae, and hair on hind knees, dark reddish brown; hair at end of abdomen chocolate color.

Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker).

Type.—Cat. No. 21654, U.S.N.M.

CENTRIS FUSCIVENTRIS, variety.

Male.—Like variety *matoensis*, but surface of upper part of clypeus with a minute tessellation (smooth in *matoensis*); fourth abdominal segment with long apprassed pale brownish hairs, appearing whitish in some lights (the same at base of segment laterally in *matoensis*).

Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker). This may be considered a subvariety of *matoensis.*

CENTRIS PROXIMA Friese.

Escuintla, Guatemala (Stella Deam); Alhajuelo, Panama (Busck).

CENTRIS CHILENSIS Spinola.

Maipu, Chili (F. V. Ibarro); Chubut, Patagonia.

CENTRIS NIGERRIMA Spinola.

Maipu, Chili (F. V. Ibarro).

CENTRIS POECILA Lepeletier.

Livingston, Guatemala (Barber and Schwarz); Tamos, Mexico (F. C. Bishopp).

CENTRIS TRICOLOR Friese.

Female.—Mendoza, Argentina (C. S. Reed). The specimen belongs to a form which has been given a distinctive name in manuscript by Friese, but it appears to be certainly conspecific with *tricolor.*

CENTRIS VULPECULA Burmeister.

Male.—Mendoza, Argentina (C. S. Reed.) I have this from Villa Encarnacion, Paraguay, sent by Schrottky as *C. lanipes* variety *tarsata* (Smith). This agrees with Friese's interpretation, but I do not think it is the true *tarsata.* Whether it should be considered a variety of *C. lanipes* I do not know; it is certainly closely allied.

CENTRIS BREVICEPS Friese.

Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker). I should consider this identical with *C. vittata* Lepeletier, did not that author positively state that the hind tarsus of the male has an "appendage" on the inner side. Friese indicates that *breviceps* is probably *vittata*, but prefers the name *breviceps* on account of Lepeletier's imperfect and faulty description.

CENTRIS MERRILLAE, new species.

Female.—Length about 14 mm., anterior wing 11. Similar to *C. lanipes* (Fabricius), but larger; pale hair of head and thorax white, with a faint creamy tint on thorax above; eyes light reddish; yellow clypeal spots elongated and oblique, so that the apical black area is broadly triangular; flagellum only obscurely red beneath; wings dilute fuliginous, quite dark; legs black; hind tibiae short, with very long ochreous hair; hind basitarsi with very long hair, which is pure black on inner side, and on outer shades into reddish-brown; fourth abdominal segment thinly covered with black hair, sides of fifth with white. Scape very short and stout, entirely black; labrum pale yellow, without spots, finely punctured, apex entire; more than basal half of mandibles yellow, apical part with a ferruginous band; vertex with black hair, but a crescent of light hair behind middle ocellus; tegulae fuscous; middle tarsi with red hair, but a long white fringe behind; apical plate of abdomen narrow.

Manaos, Brazil (Miss H. B. Merrill). Related to *C. lanipes* and *C. tarsata*, but evidently distinct.

Type.—Cat. No. 21655, U.S.N.M.

CENTRIS PLUMIPES Smith.

Near Pará, Brazil (Miss H. B. Merrill). Rio Mato, Caura district, Venezuela (Carriker).

CENTRIS PERSONATA Smith.

Near Pará, Brazil (Miss H. B. Merrill); "on Aster," Aroa, Venezuela (Carriker); Trinidad River, Panama, May 7, 1911 (A. Busck).

CENTRIS RUBELLA Smith.

Female.—Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker).

CENTRIS LILACINA, new species.

Female.—Robust, length, about 21 mm.; anterior wing, 14.6 mm.; black, with pale yellow face-markings, the abdomen entirely chestnut red with a strong violet or lilac tint; mandibles black, with three strong teeth, the two outer yellowish; labrum pale yellow, with thin red hair; clypeus yellow, with a very large club-shaped mark, the stem of which reaches the lower margin; lateral face-marks irregularly cuneiform, with a linear process above along orbit to about level of antennae; scape with a yellow band in front; flagellum entirely dark; hair of vertex and front entirely rusty black, of cheeks (except above) creamy white, some pale hair around antennae; thorax above with dense short dark gray hair, but on lower part of pleura cream-colored; scutellum strongly bituberculate; tegulae black;

wings dark fuliginous, shining purple; legs dark, the femora dark chestnut red; anterior and middle legs with black hair, but the very large scopa of hind tibiae and tarsi brilliant orange fulvous; abdomen very minutely punctured, dullish, the first segment dorsally polished and shining; apical plate much broader at end than in *C. rubella.*

Palcazu, Peru (Rosenberg). A member of the group of *C. personata*, *rubella*, etc., recognizable by the face-markings, lilacine abdomen, and structure of scutellum.

Type.—Cat. No. 21656, U.S.N.M.

CENTRIS SCHWARZI, new species.

Female.—Length, about 17 mm.; robust, agreeing in size and form and most details of color with *C. personata* Smith, but the hair of head and thorax is black, except on cheeks, where it shades into grayish chocolate, and on metathorax and hind part of scutellum, where it is pale ochreous, abruptly contrasting; clypeus with only a small cuneiform yellow mark on upper part; lateral face-marks thorn-shaped; scape with a small yellow mark; wings dark fuliginous. Labrum with long dark chocolate hairs; anterior and middle knees with a yellow spot; scopa of hind legs very large, pale fulvo-ochraceous; abdomen moderately shining, apical plate much broader at end than in *C. rubella.*

Cacao, Alta Vera Paz, Guatemala, March 26, 1906 (Barber and Schwarz).

Type.—Cat. No. 21657, U.S.N.M.

CENTRIS NIGROFASCIATA Friese.

Guayaquil, Ecuador; a long series.

CENTRIS CITROTAENIATA Gribodo.

Rio Mato, Caura district, Venezuela (Carriker); British Guiana, April 24, 1901 (R. J. Crew).

CENTRIS CAELEBS Friese.

Ibarra, Ecuador (Rosenberg).

CENTRIS ATRA Friese.

Rio Mato, Caura district, Venezuela (Carriker). The male has the wings more lilac, the female more green. *C. xylocopoides* Fox is a synonym.

EPICHARIS AFFINIS, variety QUADRINOTATA (Mocsary).

Female.—La Lajita, Rio Mato, Venezuela, October, 1909 (Carriker). Mocsary described this as a species, but it is only a variety of *E. affinis* Smith.

EPICHARIS SEMIMURINUS, new species.

Male.—Length 21 mm., anterior wing 17 mm.; the abdomen without spots or bands, the first three segments bare, the others with sparse but long and coarse black hairs; ventrally the abdomen has much long pale hair. Front broad; hair of head black; labrum large, quadrate, cream-color; clypeus entirely black, with two strong carinae converging above, between the carinae there is on the upper part a strong median groove, on each side of which are strong punctures; mandibles black, with fulvous apical patch; lateral face marks consisting of cream-colored stripes beginning between eye and mandible and extending along clypeal suture to about middle of side of clypeus; scape with a large light yellow spot in front; flagellum dark brown beneath; front with a strong longitudinal keel; thorax covered with gray hair, mixed with black anteriorly above; wings dark fuliginous, shining purple; legs as usual in the *rustica* group; hind femora very stout, with two large yellow apical spots; hind tibiae with the outer surface bright orange-yellow (a finger-like brown mark near base); hind tarsi peculiar, the basitarsus on outer side yellow, with an immense black-edged spine in front.

Campinas, Brazil, February 25, 1901 (Hempel, 402). This agrees structurally with *E. schrottkyi*, except as to the clypeal groove, but the thorax has gray hair as in *E. dejeani*.

Type.—Cat. No. 21658, U.S.N.M.

EPICHARIS ANGUSTIFRONS, new species.

Male.—Length about 19 mm., anterior wing 15 mm.; black, the abdomen without pale hair or marks above; labrum and cuneiform lateral face-marks between eye and clypeus light yellow; mandibles black, with fulvous apical patch; a pair of small oblique (converging) supraclypeal yellow marks; scape with rather indistinct yellow stripe; hair of head black, of thorax grayish-black; four anterior legs with black hair, but hind tibiae and tarsi with large, very bright orange-fulvous scopa. Superficially like *E. schrottkyi* Friese (from Maroni, Guiana), but differing as follows: front much narrower; ocelli larger; labrum smaller, with a more copious fringe of black hair; clypeus with only feeble indistinct punctures, the keels only developed at upper end, a delicate median groove from base to apex; mesothorax with distinct though scattered punctures; scutellum dull, with a shining area in anterior middle and posteriorly in middle with a deep depression; wings shining green (purple in *schrottkyi*); apical plate of abdomen large and broad; tegument of legs without any yellow; hind basitarsi with a relatively small obtuse tooth near the middle. The mouth-parts are less elongated than in *E. semimurinus.*

Campinas, Brazil, February 8, 1901 (Hempel 427).

Type.—Cat. No. 21659, U.S.N.M.

EPICHARIS MACULATA Smith.

French Guiana (W. Schaus); Rio Mato, Caura district, Venezuela (Carriker).

EPICHARIS LATERALIS Smith.

Campinas, Brazil (Hempel). The yellow marks at sides of face are not on clypeus. Hair of thorax above gray. Male with short, thick scape. Female with bright orange spot at end of mandibles; the spots on sides of face may be almost obsolete.

XENOGLOSSA DUGESI, new species.

Female.—Robust, length about 20 mm., anterior wing 13.5 mm.; black, the clypeus and labrum very dark reddish, mandibles with a variable orange band on apical part, abdomen beyond middle of second segment ferruginous; eyes dark greenish, diverging below; ocelli very large; mandibles notched at apex; scape and base and apex of flagellum reddened; third antennal joint about as long as the next two together; hair of head dark chocolate; hair of thorax black, short, and dense; tegulae piceous; wings dark fuliginous; legs dark, the femora chestnut red; hair of legs mainly black, dense and pale gray on outer apical side of anterior and middle tibiae, dark red on inner side of hind tibiae and tarsi; abdomen beyond second segment densely covered with feltlike bright fulvous hair; apical plate broad, finely transversely lineolate; under side of abdomen with dark fuscous hair.

Guanajuato, Mexico, two collected by Dr. A. Dugès. They bear the numbers 763 and 524. Closely related to *X. gabbi* (Cresson), from Costa Rica, but distinguished by the very dark wings and dark basal half of second abdominal segment. *X. fuliginosa* Gribodo, from Venezuela, has the abdomen colored as in *X. dugesi*, but the wings are quite differently colored. The legs of one specimen of *X. dugesi* carry large pollen grains, apparently of some Cucurbitaceous plant.

Type.—Cat. No. 21660, U.S.N.M.

Genus MELIPONA Illiger.

The specimens are workers, unless the contrary is stated.

1*a.* Abdomen with light tegumentary bands or markings on a black or dark ground.

2*a.* Band on second segment thick, broadly interrupted; that on first reduced to spots or obsolete.

3*a*. Hair of thorax fox red.

4*a*. Hind tibiae with a large yellow spot on inner side near end; apicolateral margins of abdomen with black hair.

MELIPONA ORBIGNYI Guérin.

Villa Rica, Paraguay; determined by Friese as *M. quinquefasciata orbignyi*, but here regarded as a distinct species.

4*b*. Hind tibiae without such a spot; face dark; clypeus dull, not polished; apicolateral margins of abdomen with white hair.

MELIPONA PHENAX, new species.

Ecuador (Baker collection). Labeled *M. anthidioides*, but not that species. True *anthidioides* is larger and has black hair on thorax.

Type.—Cat. No. 21661, U.S.N.M.

4*c*. Like the last but face marks light.

MELIPONA SCHAUSI, new species.

Length nearly 9 mm.; black, including scutellum, but axillae with conspicuous small yellow spot; face broad; clypeus very pale dull yellow, with a pair of very broad dark brown bars, not reaching upper end; pale yellow lateral face-marks filling space between clypeus and eye, thence rapidly narrowing to a point on orbital margin a short distance above level of antennae, more or less notched opposite antennal sockets; the small malar space with a minute yellow spot; labrum reddish; mandibles reddish, the edge not denticulate; scape black with a red spot at base; flagellum dark above, ferruginous beneath; front with whitish hair, top of head with hair partly black and partly red; mesothorax shining; thorax with bright fox-red hair above and at sides; tegulae clear ferruginous; wings reddish hyaline, nervures ferruginous; legs dark reddish brown, hind tibiae suffusedly somewhat paler near end; hair of legs mainly white, red on inner side of tarsi; abdomen black, with five chrome-yellow bands, that on first segment reduced to a spot on each side, the interval brown, that on second very widely interrupted, the others with variable brown marks on the yellow sublaterally; venter with shining white hair.

Cayenne (French Guiana), from collection of William Schaus. Resembles *M. marginata* Lepeletier and *M. favosa* Fabricius, but known by the interrupted band on second segment and other characters.

Type.—Cat. No. 21662, U.S.N.M.

3*b*. Hair of thorax black or almost, not red.

5*a*. Tegulae piceous; face shining black, polished.

MELIPONA ANTHIDIOIDES Lepeletier.

Rio Janeiro and Cayeiras, Brazil. I have a Brazilian specimen from F. Smith's collection.

MELIPONA ANTHIDIOIDES INTEGRIOR, new subspecies.

Band on second abdominal segment with hardly more than its middle fifth missing; that on third to fifth very narrowly or scarcely interrupted. Length, 10 mm.

Sapucay, Paraguay, "10.5. 1902."

Type.—Cat. No. 21663, U.S.N.M.

5*b*. Tegulae rufotestaceous.

6*a*. Abdominal bands white.

MELIPONA BAERI PALLESCENS Friese.

Tarata, Bolivia. Labeled by Friese *M. quinquefasciata*, var. *pallescens*.

6*b*. Abdominal bands yellow.

7*a*. Larger, anterior wing 7.7 mm.; tarsi red.

MELIPONA ANTHIDIOIDES Lepeletier.

A specimen determined as such, from Rio Janeiro; perhaps immature.

7*b*. Tarsi dark; the last joint may be red.

MELIPONA BAERI Vachal.

Tarata, Bolivia. Labeled by Friese *M. quinquefasciata*, variety *baeri* (marks on clypeus, above and at lower corners, small and suffused), and *M. quadrifasciata*, variety *bicolor* Lepeletier (marks on clypeus, including pale upper margin, distinct). The latter is not *M. bicolor* Lepeletier. These specimens represent a single species, which is distinctly smaller than *M. anthidioides*, and has very distinct light marks at sides of first abdominal segment, absent in *anthidioides*.

2*b*. Band on second abdominal segment narrowly or not interrupted, or very slender.

9*a*. Ground color of abdomen clear rufous, except at base; abdominal bands yellow, conspicuous. Length 9 mm.

MELIPONA QUADRIFASCIATA CALLURA, new subspecies.

Curityba, Brazil. Labeled by Friese *M. quadrifasciata*, variety *bicolor* Lepeletier; but it is not *M. bicolor* Lepeletier, which has no marks or bands on abdomen.

Type.—Cat. No. 21664, U.S.N.M.

9*b*. Ground color of abdomen not clear rufous, or only the basal part rufous.

10*a*. Scutellum with black or partly black hair.

11*a*. Abdominal bands broad, yellow, on first segment reduced to a mark on each side; hair of scutellum and mesothorax wholly black.

MELIPONA QUADRIFASCIATA Lepeletier.

Curityba, Brazil; determined by Friese.

11*b*. Abdominal bands extremely broad, yellow, covering all but basal third or less of segments; first segment without band or marks; front densely covered with white hair, contrasting with the black of top of head; clypeus polished, with scattered very small punctures; hind tibiae broadly yellow apically, the basitarsus also largely ocher yellow on outer side.

MELIPONA MANDACAIA Smith.

The above characters are recorded from a specimen from F. Smith's collection.

11*c*. Abdominal bands very distinct, and moderately broad, but occupying less than half segments; first segment with a well-developed and entire band; hair of thorax above not wholly black.

MELIPONA INTERMIXTA, new species.

Length about 10 mm., robust, black, with five entire pale yellow bands on abdomen, the first segment before the band red, the others sometimes dark reddish; clypeus dull ferruginous, the upper and lateral margins suffusedly blackish, the lower margin at extreme sides yellowish, and a faint suggestion of a median yellow stripe; lateral face marks with the lower end very broad and reddish, the upward extension a narrow whitish stripe along orbits to near middle of front; labrum and mandibles ferruginous, the latter not denticulate; malar space well developed; sides of face and front with thin hoary pubescence, but front and vertex generally with black, and occiput with pale ochreous; antennae, including scape, ferruginous beneath; mesothorax black, not polished; scutellum shining fusco-testaceous; axillae with a small yellow stripe; hair of thorax above brownish-black mixed with ochreous, whitish anteriorly; sides of thorax with white hair, the upper part with a large suffused fulvous patch; tegulae light ferruginous; wings dusky; legs black suffused with reddish, their hair partly dark and partly light, the fringe of hind tibiae black; apical part of abdomen with long black hair; venter with shining white hair.

British Guiana, May 27, 1901 (R. J. Crew). Allied to *M. eburnea* and *M. quadrifasciata*.

Type.—Cat No. 21665, U.S.N.M.

11*d*. Abdominal bands narrow; margin of scutellum fringed more or less with pale hair.

12*a*. Larger than 12*d*, axillae black, face without conspicuous light marks; hair of thorax above appearing gray, not fulvous; hair of pleura white, with a pale fulvous patch.

MELIPONA FASCIATA Latreille.

Para, Brazil; determined by Friese.

12*b*. MELIPONA FASCIATA PANAMICA, new subspecies.

Hair of thorax above fulvous, mixed with fuscous or black, fulvous patch on pleura bright; scutellum and axillae dull testaceous or wax color; a faint pale line down middle of clypeus. The hair on apical part of abdomen above is black, not fulvous as in *M. eburnea.* Length 9 mm.

Porto Bello, Panama, February 28, 1911 (A. Busck), = type. Also from Cabima, Panama, May 17, 1911 (A. Busck), and Alhajuelo, Panama (Busck).

Type.—Cat. No. 21666, U.S.N.M.

12*c*. MELIPONA FASCIATA COSTARICENSIS, new subspecies.

Like *M. fasciata panamica*, but differing thus: Hair of head and thorax above black, with some admixture of gray; upper part of pleura with fuscous hair, middle with fulvous, lower with white; scutellum darker. The fulvous hair on pleura may be wholly lacking. Length 9 mm.

Pozo Azul, Costa Rica, June 15, 1902 (M. A. Carriker). The abdomen is broader than in *M. solani* Cockerell, but it is very closely related. The flagellum is bright ferruginous beneath, which is not true of *solani.* The hind femora are more or less reddish, but not bright ferruginous with a black stripe beneath as in *solani. M. solani* represents the end of a series of forms deviating from *M. fasciata.*

Type.—Cat. No. 21667, U.S.N.M.

12*d*. Smaller than *M. fasciata;* axillae pale; face with conspicuous light marks (lateral marks and stripe on clypeus); ground color of abdomen black or (immature?) reddish.

MELIPONA MARGINATA GHILIANII Spinola.

Para, Brazil; determined by Friese.

12*e*. MELIPONA MARGINATA CARRIKERI, new subspecies.

The narrow abdominal bands entire. Hind margin of scutellum pale yellow; axillae with yellow bands; lateral marks of face linear, not extending much below level of top of clypeus, the latter without a stripe. Mandibles red, simple; flagellum red at tip. Length 7 mm.

Pozo Azul, Costa Rica, June 15, 1902 (M. A. Carriker). The mesothorax has yellow lateral margins; in variety *amazonica* Schulz it is entirely black.

Type.—Cat. No. 21668, U.S.N.M.

10*b*. Scutellum with reddish or pale hair.

13*a*. Scutellum black. Large species, with very narrow white abdominal bands, entire on first segment, interrupted on 2 to 4.

MELIPONA INTERRUPTA Latreille.

Para, Brazil, and Bolivia; determined by Friese.

13*b*. Scutellum and axillae black; abdominal bands broad and bright yellow.

MELIPONA ORBIGNYI JENNINGSI, new subspecies.

Male.—Band on first segment widely interrupted, the others entire, that on second notched in front; bands on segments 2 to 4 with sublateral curved dark lines; no lateral face marks, but upper margin of clypeus clear pale yellow, the edge of the dark against this yellow bilobed; lower part of cheeks with shining white hairs. Length 8.5 mm.

Las Cascadas, Canal Zone, Panama (A. H. Jennings).

Type.—Cat. No. 21669, U.S.N.M.

13*c*. Scutellum at least partly yellowish or reddish.

14*a*. Small species, about 7 mm. long; scutellum and axillae yellow; face marks very conspicuous (lateral face marks, supraclypeal mark, lower corners and median stripe on clypeus); base of abdomen ferruginous.

MELIPONA MARGINATA Lepeletier.

Sao Paulo, Brazil, determined by Friese.

14*b*. Larger.

15*a*. Rather small, with broad abdominal bands, that on first segment interrupted; scutellum and axillæ black, with fulvous or ochreous hair.

MELIPONA SCHAUSI CONVOLVULI, new subspecies.

Like *M. schausi*, with the same face-marks, etc., but abdominal bands considerably broader, and that on second segment not interrupted; no light spots on axillæ. Length, 8 mm.

"On convolvulus," C. Bolivar, Venezuela (M. A. Carriker). Related to *M. favosa* Fabricius, but scutellum different. Also apparently related to *M. mutata* Lepeletier.

Type.—Cat. No. 21670, U.S.N.M.

15*b*. Pleura with a distinct patch of golden-fulvous hair; no lateral face-marks; first abdominal segment largely or almost wholly very pale yellowish; abdominal segments 3 to 5 heavily fringed with ochraceous hair; hair on inner side of hind basitarsi shining copper-red.

MELIPONA EBURNEA Friese.

Tarata, Bolivia, and Peru; determined by Friese. Rio Charape, Peru (C. H. T. Townsend); determined by Crawford. Piches and Perene Valleys, 2,000–3,000 feet. Peru (Soc. Geogr. de Lima).

15*c*. Pleura with large patch of rufo-fulvous hair; apical dorsal segments of abdomen with sparse black hair.

MELIPONA BONITENSIS, new species.

Like *M. fulvipes*, but a little larger and more robust, with rufo-fulvous hair on pleura; scape without a yellow stripe; front with fulvous hair; hairs fringing hind tibiae black; abdominal bands cream color, on segments 2 to 4 more or less narrowed sublaterally; no fringes of white hair on last few abdominal segments; legs black. Length 10 mm. Bonito, Prov. Pernambuco, Brazil, Jan., 1883. Related to *M. fasciata*.

Type.—Cat. No. 21671, U.S.N.M.

15*d*. Similar to the last but narrower, with narrower bands on abdomen; upper part of front with black hair.

MELIPONA FASCIATA BARTICENSIS, new subspecies.

Close to *M. solani*, but differing thus: Scutellum paler and shorter, less produced apically; first abdominal segment pale fulvous, suffused with brown above; black hair on apical part of abdomen not so thick; a median pale line on clypeus and (obscurely) along orbits; hair of pleura bright rufofulvous, without a fuscous spot. Length, 9 mm.

Bartica, British Guiana, May 17, 1901, also May 20 (R. J. Crew). There is some resemblance to *M. scutellaris*.

Type.—Cat. No. 21672, U.S.N.M.

15*e*. Pleura without a patch of golden-fulvous hair; anterior corners of thorax with a patch of fulvous hair.

16*a*. Lateral face marks linear, cream color; abdominal bands entire, broad, and bright yellow.

MELIPONA SANTHILARII Lepeletier.

Parana, Brazil, and Jundiahy, Brazil; determined by Friese. Asuncion, Paraguay; determined by Schrottky. Schrottky's interpretation of *M. quinquefasciata* Lepeletier, also from Asuncion, is at least very closely allied; it is the species described by Strand as *M. paraguayaca*. Possibly all the Asuncion specimens should be united under the latter name.

16*b*. Lateral face marks narrow, yellow; abdominal bands narrow.

MELIPONA FULVIPES Guérin, variety a.

Quiriqua, Guatemala (W. P. Cockerell); Cacao, Trece Aguas, Guatemala, May, 1907 (G. P. Goll). This form has darker legs than typical *fulvipes*, but it is not sharply differentiated.

Also from Prinzapolca River, E. coast of Nicaragua.

16*c*. **Lateral face marks broad below.**

MELIPONA FULVIPES Guérin.

Puntarenas, Costa Rica (F. Knab); S. Diego, Cuba (Palmer and Riley); Guantanamo, Cuba; Kingston, Jamaica; Rio Jacinto, D. F., Mexico (Julio Riquelme). A poor specimen from F. Smith's collection is labelled *M. fulva* Lepeletier, but it is not that species; according to Ducke *M. fulva* is the same as *rufiventris*. Other specimens of *M. fulvipes*, marked (one with a query) *M. fasciculata* Smith, are from Belize, Honduras, and Izamal, Yucatan (Townsend). True *fasciculata*, according to Gribodo, is a variety of *M. interrupta*.

16*d*. Male like *M. fulvipes*, but clypeus pale yellow with two broad dark bars (in male of *fulvipes* from Gualan, Guatemala, it is black with the lower corners pale yellow).

MELIPONA LIGATA Say.

San Rafael, Mexico, middle of July (C. H. T. Townsend).

1*b*. Abdomen without pale bands, or at most apical margins of segments slightly discolored, or (*M. interrupta oblitescens*) there are fragments of bands. (*M. rufiventris* has extremely slender pale bands.)

17*a*. Abdomen clear or rather dusky fulvous or ferruginous.

18*a*. Hair of mesothorax mainly or wholly black or dark fuscous.

MELIPONA SEMINIGRA Friese.

Para, Brazil, and Obidos, Amazons; determined by Friese. Pleura with a patch of fulvous hair; abdomen shining, polished.

MELIPONA ABUNENSIS Cockerell.

Rio Madeira, Abuna, Brazil. Allied to the last, but the scutellum is entirely black.

MELIPONA FASCIATA MELANOPLEURA, new subspecies (variety?).

Like *M. fasciata costaricensis*, with the same dark hair on pleura (which separates it at once from the other forms falling in this section of the table), but abdomen ferruginous, the pale bands very obscure, the third and fourth segments with fine appressed golden hairs. The face is practically immaculate. The hair of head and thorax above is mostly black. Length about 10 mm.

Pozo Azul, Costa Rica, June 15, 1902 (M. A. Carriker). I had marked this as quite distinct from *M. fasciata*, though allied; but there are so many intermediate forms that it seems best to treat it as a variety. It is possibly no more than a dimorphic variation of *costaricensis*.

Type.—Cat. No. 21673, U.S.N.M.

MELIPONA FASCIATA TRINITATIS, new subspecies.

Like the last variety, but differing thus: Hair of pleura entirely pale, with a fulvous patch; narrow line on clypeus and lateral face marks (ending above about middle of front) cream color; hair of head and thorax above fulvous mixed with black, the general effect reddish; scutellum honey color and axillae whitish; first abdominal segment dorsally cream color; third and fourth segments without appressed golden hair. Length 10 mm.

Port of Spain, Trinidad, "11.6" (Aug. Busck).

Type.—Cat. No. 21674, U.S.N.M.

18*b*. Hair of mesothorax pale.

19*a*. Legs clear red, or red marked with black.

20*a*. Larger and more robust; hair fringing hind tibiae red.

MELIPONA PSEUDOCENTRIS Cockerell.

Described from Manaos, Brazil. One collected by Miss H. B. Merrill in the same locality only differs by lacking the bicoloration of the hind tibiae, which are wholly fulvous. It may stand as variety *a*. *M. pseudocentris* is probably not separable from *M. rufiventris* Lepeletier, as understood by Friese (from Sao Paulo, Brazil); but I here accept F. Smith's interpretation of *rufiventris*, as shown by a specimen from his collection. This appears to agree with Lepeletier's account, though the matter can not be definitely settled without examining Lepeletier's type. Smith, himself, in describing *M. mondury* Smith (which Marianno says is a synonym of *rufiventris*), remarks that *rufiventris* differs by having the inner orbits of eyes pale and the scutellum black. The specimen from his collection has the orbits as stated, but the scutellum is dull testaceous. It is also testaceous in *M. pseudocentris*.

20*b*. Smaller and narrower; abdomen with linear pale bands.

MELIPONA FLAVOLINEATA Friese=RUFIVENTRIS Lepeletier (F. Smith collection).

Para and Maranhao, Brazil; determined by Friese as *flavolineata;* near Para (Miss H. B. Merrill); Palcazu, Peru (from Rosenberg). The specimen from F. Smith's collection has the middle and hind basitarsi, middle tibiae at apex, and more than apical half of hind tibiae, black. This variation, as in the *M. pseudocentris* series, appears not to be specific; one of the Miss Merrill specimens shows the same leg-pattern, and is also peculiar for the distinctly narrower face.

As the identification of *M. rufiventris* is more or less uncertain, it may be best for the present to discard the name, and use *flavolineata* for the present insect.

19*b*. Legs black or dark; pleura with a fulvous patch.

MELIPONA PSEUDOCENTRIS MERRILLAE, new variety.

Like *M. pseudocentris*, but legs very dark reddish; hind tibiae not at all bicolored, the hairs fringing them black; scape much darker, though variable. Length 10 mm.

Manaos, Brazil, four collected by Miss H. B. Merrill. The abdomen is considerably broader than in *M. mimetica.*

Type.—Cat. No. 21675, U.S.N.M.

MELIPONA MIMETICA Cockerell.

Guayaquil, Ecuador (Brues). When publishing this species I suggested that Friese might have mixed it with his *M. fuscipes*, which he said was very rarely fulvous-haired. This surmise proves correct, as a specimen of *M. mimetica* from Guayaquil (Buchwald) is labeled *M. fuscipes* by Friese. True *fuscipes*, with ashy-fuliginous hair, and conspicuous black hair on abdominal segments 3 to 6, is certainly distinct.

MELIPONA FUSCIPES Friese.

Cacao, Trece Aguas, Alta Vera Paz, Guatemala, May, 1907 (G. P. Goll).

17*b*. Abdomen black or dark.

22*a*. Hair of thorax above mainly or wholly fulvous.

23*a*. Abdomen with much fulvous hair; hair of scutellum bright fox-red.

MELIPONA NIGRA Lepeletier.

Sao Paulo and Jundiahy, Brazil; determined by Friese. The specimens from the two localities are not quite alike.

23*b*. Abdomen comparatively little hairy.

24*a*. Larger, mainland forms.

MELIPONA SCUTELLARIS Latreille.

Pará, Brazil: determined by Friese. This has the legs dark, but one form near Pará (Miss H. B. Merrill) has red femora.

MELIPONA SCUTELLARIS ILLOTA, new subspecies.

Thorax above with much black or dark fuscous hair mixed with the fulvous; legs chestnut red, hind basitarsus and apical half of tibia black; clypeus red suffused with blackish, and with a faint median pale line. Length, 10 mm.

Palcazu, Peru; from Rosenberg.

Type.—Cat. No. 21676, U.S.N.M.

24*b*. Smaller; mainland species with yellow scutellum and axillae.

MELIPONA CONCINNULA, new species.

Length, about 9 mm.; black, with the hind legs, all the femora, and small joints of tarsi ferruginous; scutellum and axillae light yellow (not testaceous); mandibles light reddish, the blackened apical margin simple; a large bright ferruginous patch at lower end of cheeks beneath; clypeus dull, minutely roughened, with a broad median cream-colored stripe (not reaching upper end) and a spot at each extreme side; a narrow cream-colored band along inner orbits; scape with base and a line beneath to apex bright ferruginous; flagellum dull reddish beneath, broadly red at apex; front with pale ochreous hair, top of head with ferruginous; mesothorax shining, the punctures very minute; hair of thorax bright fox-red, on ventral surface white; tegulae ferruginous; wings dusky; legs with pale hair, fringe on hind margin of hind tibiae black; abdomen short and broad, black, with dull surface, hind margins of second and following segments broadly dark obscure reddish; the very inconspicuous hair of upper side of abdomen is black, with some pale; the venter has white hair. Labrum whitish, not bicolored. Margins of mesothorax partly pale.

Rio Mato, Caura district, Venezuela, October, 1909 (M. A. Carriker). The scutellum is shorter, less produced apically, than in *M. scutellaris.*

Type.—Cat. No. 21677, U.S.N.M.

24*c.* Small species of the Lesser Antilles.

MELIPONA VARIEGATIPES Gribodo.

Montserrat (C. V. Riley); also four from Dominica.

MELIPONA VARIEGATIPES LAUTIPES, new variety.

Legs ferruginous, without the characteristic "*variegatipes*" markings. Length, 7 mm.

Montserrat, March 3, 1894 (C. V. Riley). A variation similar to those recorded above in *M. pseudocentris* and *M. flavolineata.* It is doubtless recessive to the typical form, with which it occurs in small numbers.

Type.—Cat No. 21678, U.S.N.M.

22*b.* Mesothorax with mainly black hair, scutellum with red; lateral face-marks conspicuous.

MELIPONA VULPINA, new species.

Length, about 10 mm.; broad and robust, black, including the legs, except that the femora have a suffused red band above; scutellum dull testaceous; mandibles ferruginous, the dusky margin simple; cheeks wholly black; labrum pallid; clypeus entirely dull, its lower margin cream-color except a small interval on each side of middle; vertical stripe on clypeus narrow and obscure, not extending very much above middle; lateral face-marks broadened below, conspicuous; scape long, black, with the extreme base red; flagellum dull red beneath, brighter apically; lower part of cheeks with glistening white hair, but upper part, with front and top of head, with the hair nearly all black; mesothorax with black hair, copiously intermixed with pale ochreous anteriorly; scutellum and upper part of pleura ith very bright fox-red hair; under side of thorax with white hair; gulae red; wings dusky reddish; legs with pale and black hair, that inging hind tibiae black; abdomen short and broad, black, with short stiff black hair, hind margins of second and following segments with thin inconspicuous fringes of pale hair; middle of venter with shining silvery-white hair.

Rio de Janeiro, Brazil, July, 1915 (P. G. Russell).

Type.—Cat. No. 21679, U.S.N.M.

22*c*. Hair of thorax above white, with a bright fulvous patch at each anterior corner of mesothorax, but none on pleura. Fragments of abdominal bands present. Hair fringing hind tibiae white.

MELIPONA INTERRUPTA OBLITESCENS, new subspecies.

Surinam; from Mr. Sladen, who determined it as *mutata* Lepeletier, which is an entirely different species, with red hair on thorax. This is a race of *interrupta*, with large pale supraclypeal mark, but clypeal stripe reduced to a triangle on lower margin; pale band on first abdominal segment broken into fragments and those on the other segments reduced to lateral marks.

Type.—In the author's collection.

22*d*. Hair of thorax above wholly or mainly black.

25*a*. Small, anterior wing about 5.3 mm. long; face-marks ivory color, clear-cut, and distinct.

MELIPONA MARGINATA ATRATULA Friese.

Jundiahy and Blumenau, Brazil; determined by Friese.

25*b*. Larger.

26*a*. Basin of first abdominal segment and hind margins of segments whitish or reddish; abdomen smooth, polished, and shining; very little hair on disk.

MELIPONA FUSCATA Lepeletier.

Para, Brazil; determined by Friese. Mapiri, Bolivia; received from Schrottky.

26*b*. Abdomen not thus marked.

27*a*. Large and robust, abdomen about 6 mm. wide; face shining black.

MELIPONA FLAVIPENNIS Smith (TITANIA Gribodo).

Guayaquil, Ecuador, and Mapiri, Bolivia; determined by Friese. Also from Costa Rica; Pozo Azul (Carriker) and Juan Vinas (William Schaus).

27*b*. Much smaller; clypeus dull; abdomen wholly without pale hair bands.

MELIPONA PERUVIANA Friese.

Huancabamba, Peru, 3,000 m.; determined by Friese.

27*c*. Resembling *M. fuscata* and *M. peruviana*, but very distinct. Abdomen with distinct pale hair bands. Pleura with a fulvous patch, varying to fuscous.

MELIPONA FASCIATA INDECISA, new subspecies.

Like *M. fasciata costaricensis*, but abdomen wholly without tegumentary bands. Very close to *M. solani* Cockerell, but differing by the dark reddish to black hind femora, and flagellum ferruginous beneath. It is, however, as near to *solani* as to *costaricensis*, being intermediate between the two, and strongly suggesting the reference of *solani* to *fasciata* as another race. Length, 10 mm.

Lagunita de Aroa, Venuezcla, 2,000 feet (M. A. Carriker).

Type.—Cat. No. 21680, U.S.N.M.

ANTHOPHORA ZONATA (Linnaeus).

Female.—Brisbane, Queensland, February 10, 1907.

ANTHOPHORA AERUGINOSA Smith.

Male.—Duaringa, Dawson district, Queensland; from W. F. H. Rosenberg.

ANTHOPHORA SCYMNA Gribodo.

Male.—Waroona, Western Australia, February 15, 1909 (G. F. Berthoud). This species was described from a female, but the male before me appears to belong to it. The clypeus, broad supraclypeal mark, lateral face marks filling space between clypeus and eyes, labrum, base of mandibles, and scape in front are all bright chrome yellow. The flagellum is black, with an imperfect red stripe beneath.

ANTHOPHORA PULCHERRIMA Bingham.

Female.—Pognor La, Rupshu, Ladak, 16,000 feet altitude, July 22 and 23, 1897 (W. L. Abbott). Bingham's description is rather inadequate, as he does not distinctly indicate the black hair on head (except clypeal region and middle of vertex) and pleura. I have the species from Khamba Jong, Sikkim (15), 16,000 feet altitude, July (British Tibet Expedition).

TETRALONIA FLORALIA Smith.

Soochow, China, 5 males (N. Gist Gee, 127). A little smaller than *T. nipponensis* (Pérez), but very closely allied. The third antennal joint is much shorter than in *T. chinensis*.

PROSOPIS ITAMUCA Cockerell.

Female.—Brisbane, Queensland, December 23, 1904.

PROSOPIS (NESOPROSOPIS) PUBESCENS (Perkins).

Female.—Hilo, Hawaii, July (H. W. Henshaw). Agrees with one from Perkins. There is also one from Olaa, Hawaii, July 18 (W. H. Ashmead).

AUGOCHLORA FLAMMEA Smith.

Female.—Tacubaya, Mexico (O. W. Barrett); Motzorongo, Vera Cruz, Mexico, January (H. Osborn). Compared with one from F. Smith's collection.

AUGOCHLORA VESTA TERPSICHORE (Holmberg).

Female.—Zaruma, Ecuador, January 30, 1916 (F. W. Rohwer).

MEGALOPTA IDALIA Smith.

Cayenne (French Guiana), both sexes collected by Wm. Schaus.

MEGALOPTA FORNIX Vachal.

Female.—Chauchamayo, Peru; from W. F. H. Rosenberg. I suppose this large form is Vachal's *fornix*, as it agrees in nearly all respects; the lateral ocelli are, however, distant from the occipital border much less than twice the diameter of an ocellus.

MEGALOPTA FORNIX PANAMENSIS, new subspecies.

Female.—Similar to the Peruvian insect just recorded, but smaller, 13–14 mm. long, anterior wing 10.5 to 12 mm.; lateral ocelli distant from occipital border much less than twice diameter of an ocellus; protuberance on labrum thick, not like a horseshoe. These characters would appear to refer the insect to the Brazilian *M. sodalis* Vachal, but the third antennal joint is conspicuously longer than the fourth, as in *fornix.*

Male.—What I suppose to be the male of this subspecies has the abdominal structure and general appearance of *M. idalia*, but the face below the antennae is testaceous delicately suffused with green (not bicolored), the flagellum is wholly ferruginous (not darkened apically), and the area of metathorax, though shining and polished in middle, is quite large.

Female (type).—Trinidad Rio, Panama, March 23, 1912 (Busck); also Boquete, Chiriqui, Panama; male, Paraiso, Canal Zone, Panama, January 28, 1911 (Busck). If the insect from Peru cited above is separable from *M. fornix*, the species will stand as *M. panamensis*, with the Panama form as typical.

Type.—Cat. No. 21681, U.S.N.M.

MEGALOPTA TABASCANA, new species.

Male.—Length a little over 12 mm., anterior wing 10; general form and appearance as in the *M. idalia* group, but first two abdominal segments dull rufo-testaceous, with the hind margins broadly blackened: remaining segments dark, with strong yellowish-green tints, the third obscurely reddish basally; third ventral segment with a deep median sulcus reaching to the base, as in the Peruvian *M. aethantis* Vachal. Head and thorax yellowish green; labrum and lower margin of clypeus broadly whitish; mandibles whitish basally, ferruginous apically; flagellum long, crenulated, dusky above, becoming black on apical part; lateral ocelli about as distant from occipital margin as the diameter of one; thorax dorsally with faint coppery tints; postscutellum much shorter than scutellum, with thin hair not hiding the surface; area of metathorax rather large, angular posteriorly, finely striate all over; prothorax testaceous; wings yellowish hyaline; first recurrent nervure meeting second transverse cubital; legs testaceous.

Frontera, Tabasco, Mexico. Allied to *M. aegis* Vachal and *M. aethautis* Vachal, but distinct from both by the combination of thoracic and abdominal characters.

Type.—Cat. No. 21682, U.S.N.M.

NOMIA, subgenus NOMIAPIS, new subgenus.

This is proposed for the subgenus described by me[1] as typical *Nomia;* type *N. diversipes* Latreille. Meade-Waldo has shown that the Asiatic *N. curvipes* is the true type of *Nomia.*

MEGACHILE ATRATA Smith.

Female.—Fergusson Island, British New Guinea. This is the form with dark fuliginous wings; it agrees with one from Amboina, from F. Smith's collection. The form with translucent orange-tinted wings, broadly pale fuscous on outer margin, which I have from Sumatra (from F. Smith's collection), is to be called *M. atrata*, variety *fulvipennis* (*M. fulvipennis* Smith).

MEGACHILE DISJUNCTIFORMIS Cockerell.

Female.—Tai-peh, Formosa, June 15, 1896.

MEGACHILE MYSTACEA (Fabricius).

Female.—Brisbane, Queensland, November 28, 1904.

MEGACHILE RUFIPES (Fabricius).

Female.—Axim, Gold Coast, Africa; from C. R. Mengel.

COELIOXYS SAUTERI (Cockerell).

Female.—Tai-peh, Formosa, July 31, 1896. Described as a subspecies of *C. afra.*

COLLETES BICOLOR Smith.

Female.—Bahia Blanca. Argentina (L. Bruner, 6).

AGAPOSTEMON FESTIVUS Cresson.

Male.—San Francisco Mountains, Santo Domingo, West Indies, September, 1905 (A. Busck). The hind femora have a small tooth beneath. According to Baker, this is the male of *A. poeyi* Lucas.

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[1] Proc. U. S. Nat. Mus., vol. 38, p. 289.

AGAPOSTEMON RADIATUS PORTORICENSIS, new subspecies.

Male.—Length about 9 mm. Abdomen a little more distinctly metallic, but base of first segment ferruginous instead of green and the yellow band interrupted by ferruginous; underside of abdomen yellowish-red, without distinct markings; middle and hind tibiae suffusedly ferruginous on outer side; dark parts of first and second abdominal segments considerably smoother than in *radiatus*.

Mayaguez, Porto Rico, January, 1899, two males (Aug. Busck).

Type.—Cat. No. 21683, U. S. N. M.

Genus TRIGONA Jurine.

The following table separates the African species represented in the United States National Museum. Nearly all the species were received from Doctor Friese and determined by him. The specimens are workers, unless the contrary is stated.

1*a*. Scutellum entirely pale or yellow, except a small black mark at base; lateral margins of mesothorax pale; species not minute.

2*a*. Abdomen of worker dark, with suffused light marks at sides; greater part of clypeus black. (Male abdomen testaceous, with a dark triangle or second segment.)

TRIGONA BECCARII Gribodo.

I possess a cotype of this species, from Keren, Abyssinia, collected by Beccari.

2*b*. Like *T. beccarii* (worker), except that there is more light color on scape, and the clypeus is yellow, with a narrow black band along anterior margin, and a pair of oblique reddish marks above.

TRIGONA BECCARII JOMBENENSIS Cockerell.

Jombene Range, East Africa (Chanler-Hohnel Expedition).

2*c*. Abdominal segments rufotestaceous, with broad dark margins.

TRIGONA BECCARII NIGRIFACIES Friese.

1*b*. Scutellum black, with a broad yellow margin; species not minute.

1*c*. Scutellum all dark.

3*a*. Abdomen greatly elongated, narrow, so that the insect looks like some wasp; polished black, wings fuliginous.

TRIGONA STAUDINGERI Gribodo.

3*b*. Abdomen otherwise.

4*a*. Very small species.

5*a*. Mesothorax polished; wings brownish.

TRIGONA CURRIEI Cockerell.

Worker. Length about 3 mm., robust, black; head large and quadrate; mandibles and base of scape red; clypeus with a median groove; whole body polished and shining; cheeks very broad; tegulae fuscous; wings dilute brownish, stigma pale with a dusky margin; legs obscurely reddish; abdomen short and broad, the first segment very obscurely more or less reddish. Related to *T. magrettii* Friese, but easily separated by the brownish wings. The head also is quite broad.

Mount Coffee, Liberia, April, 1897 (R. P. Currie).

5*b*. Wings clear hyaline, a little milky.

6*a*. Mesothorax polished; antennae low down on face.

TRIGONA MAGRETTII Friese (Old Calabar).

TRIGONA BOTTEGOI Magretti (Somaliland).

The *T. magrettii* was determined by Friese; the *T. bottegoi* came from the Magretti collection. In spite of the widely different localities, I can not see any difference. Apparently *T. magrettii* falls as a synonym.

6*b*. Mesothorax dull; labrum pale or yellow.

7*a*. Abdomen brown, hind margins of segments pallid; "eyes red" (Friese).

TRIGONA GRIBODOI Magretti.

Three specimens are from Luebo, Congo (D. W. Snyder).

7*b*. Abdomen red basally and black apically; "eyes black" (Friese).

TRIGONA BRAUNSI Kohl.

Very closely allied to the last.

4*b*. Species not minute.

8*a*. Abdomen entirely black or piceous; mesothorax not polished; wings dilute brownish.

9*a*. Larger, anterior wing about 6 mm. long; hind tibia very broad; no light face marks.

TRIGONA TOGOENSIS JUNODI Friese.

9*b*. Smaller, with light face marks.

10*a*. Light face marks consisting of triangular supraclypeal mark, lateral bands along orbits, and transverse clypeal band having a median vertical process; tubercles light.

TRIGONA LENDLIANA Friese.

10*b*. Light face marks confined to broad band on lower margin of clypeus, and small obscure lateral marks.

TRIGONA CLYPEATA Friese.

8*b*. Abdomen at least partly red or light; mesothorax not polished.

11*a*. Face black, with pruinose pubescence; abdomen varying from red at base only, to reddish with hind margins of segments black.

TRIGONA TOGOENSIS Stadelmann.

11*b*. Lower margin of clypeus with a dull white band; abdomen lively orange fulvous, with hind margins of segments black.

TRIGONA ZEBRA Friese.

This has been considered a variety of *T. clypeata*, but it seems to be distinct. Another related form is *T. quagga* Strand.

11*c*. Clypeus, supraclypeal mark and broad lateral face-marks cream-color or yellow; clypeus with two faint brownish clouds, not always evident.

TRIGONA NEBULATA Smith.

There are specimens of this from Mount Coffee, Liberia, May, 1897 (R. P. Currie).

The United States National Museum contains 10 species of Asiatic *Trigona*, of which only the following calls for remark:

TRIGONA BIROI Friese.

The type of this species must be considered to be one of those collected in New Guinea by Biró. Friese records it at the same time from the Philippine Islands, where it seems to be common. Specimens come from Los Banos (Baker), and others were collected by C. R. Jones in a locality not specified. Three are from flowers of *Nipa fruticans*, "Lamao, Batan," February 26, 1916 (P. J. Weeter). For the present it is assumed that all these insects are the same, but it may be that the Philippine form is distinct from that of New Guinea, and possibly there is more than one sort in the Philippines. The specimens are mostly in poor condition, so that it is impossible to be sure of all their characters. The Philippine *T. biroi* has a red scape, and although very close to the Australian *T. carbonaria*, I am sure it is a distinct species.

TETRAPEDIA CALCARATA Cresson.

St. Lucrecia, Vera Cruz, Mexico (F. Knab).

CHELOSTOMOIDES PRATTI Cockerell.

San José de Guaymas, Mexico, April 10, 2 females (L. O. Howard). New to Mexico; previously known only from Texas.

EULAEMA NIGRITA Lepeletier.

Male.—Bogova, Chirique (Rosenberg).

NOMADA CRUCIS Cockerell.

Female.—Meadow Valley, Mexico (Townsend).

AGAPOSTEMON TEXANUS Cresson.

Male.—San Juan Allende, Mexico, 11.29 (Townsend).

HALICTUS SEMIVIRIDIS Friese.

Male.—Spanish Point, Bermuda, July 5, 1910 (Reynold Spaeth). Friese described the female. The male has labrum and apex of clypeus ferruginous; antennae very long, flagellum dull pale reddish beneath; tibiae at base and apex, and the tarsi ferruginous.

MEGACHILE RHODOPUS Cockerell.

Female.—Mexico (Baker 1785).

MEGACHILE THORACICA Smith.

Female.—Buitenzorg, Java, March, 1909 (Bryant and Palmer). This has remarkable clavate hairs, as described by Smith. The hair on the face is only partly black; that surrounding the clypeus is creamy-white, and the lower margin of clypeus is fringed with ferruginous hair. The disk of mesothorax is shining between the punctures.

MEGACHILE DIMIDIATA Smith.

Meade-Waldo[1] states that *M. velutina* Smith is a synonym of *dimidiata*. The species is said to have red antennae and fulvous legs, and Meade-Waldo remarks that "the original descriptions of both species distinctly state that the legs are fulvous." As a matter of fact, the descriptions do not so state, but imply that they are black, with fulvous *hair*. *M. dimidiata* is said to have red antennae. *M. erythropoda* Cameron, from Singapore, is also of this immediate alliance; it has red legs and the scape is rufous. A female labeled Punjab and United Provinces, India, VI–X (R. L. Woglum), is evidently the genuine *M. velutina*, described from "northern India." It has black legs and antennae. The insect from Trong, Lower Siam, collected by Dr. W. L. Abbott in 1899, and identified by me as *M. velutina*, is smaller (length 16 mm.), with brighter red hair, and outer margin of apical half of mandibles much more convex. The antennae are black, but the legs obscurely more or less reddish. This insect represents a distinct subspecies, and may be known as *Megachile velutina abbottiana*.

If, as is quite probable, all these insects are to be regarded as subspecies of *M. dimidiata*, the nomenclature will be:

Megachile dimidiata Smith.

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[1] Ann. Mag. Hist., November, 1912, vol. 10, p. 468.

Megachile dimidiata velutina Smith.
Megachile dimidiata abbottiana Cockerell.
Megachile dimidiata erythropoda Cameron.

MEGACHILE BENTONI, new species.

Female.—Length a little over 11 mm.; black, not very broad, with mainly ochreous pubescence; clypeus very densely rugosopunctate, without any keel or smooth line, its lower margin irregularly denticulate; a shining area just above top of clypeus; mandibles with the long cutting edge very oblique, the teeth feeble, except the sharp apical one; face with pale brownish hair, fuscous on middle of clypeus, dense and almost white at sides; front and vertex with long black or dark fuscous hair; cheeks and occiput with whitish hair; mesothorax and scutellum very densely punctured; dorsum of thorax with ochreous hair, but black on disk of mesothorax; at sides of thorax the hair is pale ochreous, becoming dull white beneath; tegulae bright ferruginous; wings dusky hyaline; legs black, the hair pale, on inner side of tarsi bright red; hind basitarsi parallel-sided, not especially broad; abdomen glistening, the first two segments with ochreous pubescence, the others with black, but segments 2 to 5 with conspicuous entire reddish-ochreous hair-bands; ventral scopa pale reddish, black only at apex of last segment.

Menserah, Northwest Provinces, India, March 1906 (Frank Benton). Among the Indian species perhaps nearest to *M. fulvofasciata* Radoszkowski, from which it is readily known by the four entire abdominal bands. Bingham places *fulvofasciata* as a doubtful synonym of *M. amputata* Smith, but the description indicates a quite different species, only 10 mm. long. *M. bentoni* has a strong superficial resemblance to the European *M. argentata.*

Type.—Cat No. 21692, U.S.N.M.

MEGACHILE ARCUATA, new species.

Female.—Length about 13.5 mm.; black, rather robust, resembling a *Lithurgus;* head large, face and cheeks very broad; mandibles elongate, tridentate, with a tubercle on inner border; maxillary palpi with long dark hair; clypeus broad, concave, smooth, presenting a shining basin bounded on each side by a large oblique keel; supraclypeal area also presenting a smooth basin, bounded above and at sides by an arcuate raised margin; antennae black; cheeks with strong punctures running together in rows; sides of face, sides of metathorax, tuft behind wings, fringe on tubercles, and ventral surface of thorax with white hair, but the head and thorax otherwise with sparse black hair; mesothorax and scutellum densely and coarsely rugosopunctate; tegulae black, finely punctured; wings hyaline, the apical margin broadly dusky, marginal cell very obtuse at end; legs with thin white hair, dense and shining on middle tarsi; spurs black; hind basitarsi narrow, not modified; abdomen dullish, more shining apically, with large not very close punctures, and no distinct hair-bands; second and third segments deeply grooved at base; first segment with white hair at extreme sides; the others with short pure white hair bands at sides, hardly noticeable from above, but conspicuous in lateral view; ventral scopa shining yellowish-white, black on last segment and on apical middle of penultimate one.

Type.—Cat. No. 21693 U.S.N.M.

Punjab and United Provinces, VI–X (R. L. Woglum). A very distinct species, recalling *Megachile longula* Fox, from Lower California, which was described as a *Lithurgus.* The insect may be placed in the Asiatic fauna next to the large species of the subgenus *Eumegachile*, which it resembles more or less in structure. The genus *Megachile* is richly represented in the Indian region, and the accurate classification of the species presents a problem of considerable difficulty. Northeastward and in Baluchistan there is a large Palaearctic element. Some years ago Major Nurse kindly communicated to me some records and synonymy which ought to be published, as follows:

Megachile ulrica Nurse is *M. terminata* Morawitz.
Megachile nadia Nurse is *M. rotundata* Fabricius.
Megachile appia Nurse is *M. centuncularis* Linnaeus.
Megachile lerma Cameron is *M. umbripennis* Smith.
Megachile rugicauda Cameron is *M. patellimana* Spinola.
Megachile creusa Bingham is *M. flavipes* Spinola.

It is also known that *M. gathela* Cameron is *M. nana* Bingham; *M. bombayensis* Cameron is *M. hera* Bingham; *M. erythrostoma* Cameron is also *hera.*

Some of Cameron's supposed *Megachile* belong to other genera:

Megachile anonyma Cameron=*Osmia anonyma.*
Megachile phaola Cameron=*Heriades phaola.*
Megachile saphira Cameron=*Heriades saphira.*
Megachile elfroma Cameron=*Heriades elfroma.*

The following were taken by Major Nurse and determined by Friese:

(1) At Deesa. *Megachile seraxensis* Radoszkowski.

(2) At Quetta. *Megachile morawitzi* Radoszkowski; *M. viridicollis* Morawitz; *M. multispinosa* Morawitz; *M. argentata* Linnaeus; *M. desertorum* Morawitz; and *M. asiatica* Morawitz.

MEGACHILE TUXTLA Cresson.

Mexico, D. F. (Inda, 46.59). Both sexes; the male represents a variety with hair on apical segments of abdomen greyish-white instead of golden.

MEGACHILE ALBITARSIS Cresson.

Mexico (Baker collection, 1785). A male *M. rhodopus* Cockerell carries the same number.

MEGACHILE LATIMANUS Say.

Mexico (Baker collection, 2320). Both sexes. This is identical with the Rocky Mountain species which I have regarded as *latimanus;* it is possible that the true species of Say is separable, but I have not the materials on which to reach a decision.

MEGACHILE NIGROMIXTA, new species.

Male.—Length about 8 mm., anterior wing 6.5; black, including the legs (anterior tarsi simple), the long slender flagellum obscurely brownish beneath; head broader than thorax; face and front covered with long yellowish-white hair, the upper part of clypeus also with very long black hairs, largely mixed with the others, and not forming a definite fringe; vertex with inconspicuous long dark hairs and sparse short pale ones; vertex broad, closely punctured, but glistening; thorax above well punctured, but somewhat shining; hair of thorax pale, mixed with black above, especially on scutellum, and a patch of black hair on middle of pleura; tegulae black; wings dilute fuliginous, the costal region darker, shining violaceous; legs with pale hair, yellowish on inner side of tarsi; anterior coxae flattened and shining in front, with stout spines; middle and hind femora and hind tibiae stout; abdomen shining, segments 1 to 4 with pale ochreous hair-bands at sides only; disk of second segment with long black hair; fifth segment with an entire band; sixth above covered with ochreous hair, the keel obtusely bilobed; venter with two entire hair-bands.

Mexico (type), from Baker collection (1785). Also one from Guatemala (Baker collection, 1783). Superficially like *M. gualanensis* Cockerell, but easily separated by the much larger head, darker wings, and bilobed end of abdomen.

Type.—Cat. No. 21684, U.S.N.M.

MEGACHILE KNABI, new species.

Male.—Length about 10 mm.; anterior wing 6.8; black, moderately robust, antennae slender, and simple; face and front covered with shining white hair, and cheeks below with a stiff dense fringe of the same; mandibles broadly triangularly expanded below, the margins of expanded part conspicuously hairy, the inner slope with a dense pale yellowish fringe; vertex with strong, very dense punctures, mesothorax and scutellum with the same; thorax with white hair, thin dorsally, not mixed with black; base of metathoracic area rugulose; tegulae black; wings dusky, especially toward apex; legs with pale hair; anterior coxae with rather short spines; anterior tarsi black, but very remarkable, the first two joints broadly expanded and quadrate, densely covered with pure white hair on outer side, third joint with a large rounded lateral expansion, but only the other part of the joint covered with white hair; middle tarsi curved. densely covered with silky hair, yellowish on inner side; hind tarsi with a glittering white fringe of hair anteriorly; abdomen shining, well punctured, apical margins of first three segments with fulvous hair bands, failing in middle, but reinforced by fulvous hair at extreme bases of segments following; segments 4 to 6 densely covered with bright reddish fulvous hair; keel of sixth segment with two large rounded lobes.

Cordoba, Mexico, Dec. 20, 1907 (F. Knab). Related to *M. occidentalis* Fox, but easily separated by the peculiar anterior tarsi, which are not elongated, and the fulvous hair on abdomen.

Type.—Cat. No. 21685, U.S.N.M.

MEGACHILE HOWARDI, new species.

Male (type).—Length 10 to 11 mm.; anterior wing 7.7; black, parallel-sided; antennae black, not modified; legs black, with the anterior tarsi clear pale yellow, with pure white hair on outer side; first joint of anterior tarsi hollowed, boat-shaped, the orange-tinted apex not reaching end of second joint, the inner margin fringed with black hair; second and third joints broadened, the whole tarsus with a large posterior hair fringe, which is tipped with ferruginous, while on the inner surface of the tarsus are two dark spots. Face densely covered with pure white hair, a few brown ones from upper edge of clypeus; vertex with hair partly brown, but rest of head with white hair; surface of vertex, mesothorax, and scutellum dull, impunctate; hair of thorax wholly white; tegulae dark brown; wings hyaline, with a brown cloud beyond marginal cell; anterior coxae with very long spines, from the outer side of which are very long hairs, standing at right angles to spine; middle tarsi with a fringe of very long white hair behind; abdomen shining black, with narrow entire pure white hair bands on segments 2 to 5; disk of fifth segment with abundant black or dark brown hair; keel of sixth segment variably emarginate, the very broad rounded lobes more or less jagged.

Female.—Similar, except for the usual sexual differences, the vertex distinctly punctured, the scutello-mesothoracic suture with a line of white hair (wholly lacking in male), the clypeus beset with long stiff black hair. The hind basitarsi are hardly broadened; the ventral scopa is white (carrying orange pollen), black at tip of last segment.

San José de Guaymas, Mexico. April 10 (L. O. Howard). The female, which is possibly a different species, nearly agrees with the description of *M. zaptlana* Cresson, but it is smaller and has no black hair on abdomen before the fifth segment. There is also some resemblance to *M. chichimeca* Cresson, but that has a broad hind basitarsus. The mandibles of the male are formed somewhat as in *M. furcata* Vachal.

Type.—Cat. No. 21686, U.S.N.M.

MEGACHILE POCULIFERA, new species.

Male.—Length about 12 mm.; anterior wing 8.9; black, including the slender antennae; form parallel-sided, but abdomen not very long; head broad; eyes black above and posteriorly, green below and in front, the separation of the two colors diagonal; face densely covered with pale fulvous-tinted hair (wholly without black), strongly contrasting with the pure white hair of cheeks; white fringe on lower side of head continued to outer side of coxae; vertex finely punctured; mesothorax and scutellum dull, the punctures hardly visible under a lens; a narrow white line of hair in scutello-mesothoracic suture; hair of thorax white at sides and below, above scanty and not so clear white, that on disk of scutellum brown; the vertex also has long fuscous hair; tegulae dark brown; wings strongly suffused with brown, especially in the costal and apical regions; legs very dark brownish, with white hair, pale orange on inner side of middle and hind tarsi; anterior coxae with very long spines, from the basal part of which long white hairs extend posteriorly; apex of anterior tibiae yellow; anterior tarsi bright yellow, with a long posterior fringe, which is largely ferruginous apically; first joint boat-shaped, extremely deeply hollowed, but not very long, its inner margin with a black fringe; the other joints essentially as in *M. howardi;* middle femora with a sharp tooth on middle of under side; middle tarsi densely clothed with white hair on outer side; middle and hind tarsi ferruginous apically; abdomen shining, the segments with white hair bands; hair on disk of segment 2 brown, on the others black, long and coarse on fifth; keel of sixth segment emarginate in middle, and strongly jagged or dentate with about three teeth on each side; no ventral spines.

Mexico. (Baker collection, 1785.) Related to *M. howardi*, but larger, with yellow hair on face and other characters.

Type.—Cat. No. 21687, U.S.N.M.

MEGACHILE NIGROLATERALIS, new species.

Female.—Length about 12 mm., robust, with broad conical abdomen; black, including antennæ, the legs obscurely reddish; head broad; eyes green; mandibles quadridentate, with apical tuft of fox-red hair; clypeus and supraclypeal area shining, with large punctures; hair of face, cheeks, and occiput pale yellowish, of vertex black; vertex well punctured, with a shining smooth spot on posterior middle; mesothorax and scutellum dull, the disk of mesothorax a little shining, with well-separated punctures; hair of mesothorax very short and black (a little pale in front), of scutellum long and black, but a broad dull white band in scutello-mesothoracic suture, and a broad pale ochreous hair band on each side over tegula; a pale hair band in suture between scutella, and mesothorax with large tufts of white hair at sides, but in middle with mixed black and white; pleura with black hair, but tubercles marked by a dense pale yellow tuft; tegulae chestnut color; wings dilute brownish; legs ordinary, anterior tarsi short, hind basitarsi broadened; abdomen shining, with fine punctures, the segments with very thin hardly noticeable white hair bands, best developed on 1 to 3; sixth segment straight in profile, with erect black hair; ventral scopa white, black on last segment and apex of penultimate.

Mexico (Baker collection, 2320). Related to *M. breviuscula* Smith; recognizable especially by the black-haired pleura.

Type.—Cat. No. 21688, U.S.N.M.

MEGACHILE TEXANA Cresson.

Mexico (Baker collection, 2320).

MEGACHILE MENDOZANA Cockerell (RHINOCEROS Friese).

Female.—Carcarana, Argentina (Bruner, 23).

MEGACHILE LENTICULA Vachal.

Female.—Palcazu, Peru (Rosenberg). One specimen, certainly not a different species, is peculiar for the polished scutellum, the upper surface almost impunctate, and the hind part of disk of mesothorax with widely separated punctures.

MEGACHILE PORRECTULA Cockerell (ACUTA Vachal).

Male.—Matucana, Peru, Jan. 30, 1913 (C. H. T. Townsend).

MEGACHILE EULALIAE, new species.

Female.—Length: 11.5–12 mm., robust, intense black, with black hair. On the cheeks, behind the eyes, is a band of creamy white or pale yellowish hair, not always present; the anterior and middle tibiae are clothed posteriorly, especially toward the apex, with hair which shines pale yellowish in certain lights; the hind femora and tibiae are covered posteriorly with very fine short pale grayish-yellow hair; hair on inner side of tarsi reddish. First two joints of labial palpi about equal; mandibles broad, quadridentate; clypeus closely and very strongly punctured, with no smooth line; the lower margin irregular, thickened, and somewhat elevated; supraclypeal area strongly punctured, with a median impunctate space; antennae entirely dark; front densely granular, dull; mesothorax and scutellum dull, closely punctured, the punctures on disk of mesothorax posteriorly well separated; wings strongly smoky; abdomen shining, distinctly punctured; ventral scopa black at sides, base, and on last segment, otherwise shining white.

Santa Eulalia, Peru, Jan. 18, 1913 (C. H. T. Townsend).

Type.—Cat. No. 21689, U.S.N.M.

Superficially like *M. huascari* Cockerell, but easily separated by the quite different ventral scopa, the dull mesothaorax, etc. Vachal described a series of black *Megachile* of this general type; these may be distinguished from each other and from *M. eulaliae*, as follows:

Ventral scopa pale or red at end.................... 1
Ventral scopa at least black on last segment.................... 2
1. Larger, 13–14 mm. long (Bolivia and Ecuador).................... *aequilibra* Vachal.
Smaller, 9.5 mm. long, ventral scopa entirely red (Chile). *flammiventris* Vachal.
2. Larger, 14 mm. long; wings hyaline, washed with yellow basally (Bolivia). *atricoma* Vachal.
Smaller, not over 12 mm.................... 3
3. Wings hyaline, not grayish or smoky; border of clypeus sinuate (Bolivia). *latula* Vachal.
Wings grayish or bronzy or dark.................... 4
4. Mesothorax and scutellum smooth and polished; ventral scopa pale in middle (Peru and Bolivia).................... *tergina* Vachal.
Mesothorax and scutellum well punctured or not polished.................... 5
5. Ventral scopa black; punctures of mesothorax and scutellum very large and dense (Mendoza).................... *orcina* Vachal.
Ventral scopa partly pale.................... 6
6. Scopa orange in middle; wings grayish hyaline (Mendoza)....*nigella* Vachal.
Scopa white in middle; wings strongly smoky (Peru)......*eulaliae* Cockerell.

MEGACHILE PERENENSIS, new species.

Length about 11 mm.; anterior wing, 9.5; very robust; black; the tarsi reddish apically; general effect of the abundant pubescence dark reddish; vertex and front with very long hair, partly black and partly ferruginous, the latter especially around the ocelli; cheeks with pale reddish hair, partly dark below; face with mainly black hair, but pale at each side next to clypeus; thorax above with mixed ferruginous and dark-brown hair, at sides with ferruginous, shading into white beneath; legs with short black or dark fuscous hair, but a good deal of white on femora and trochanters, and dark red on inner side of tarsi; abdomen dorsally thickly covered with dark red hair, the hind margins of segments with indistinct paler bands, last segment with some appressed black hair; ventral scopa white at base, red in middle, and reddish-black on last three segments; in addition, ventral segments 2 to 5 have marginal bands of white hair, broadly interrupted in middle. Mandibles broad, quadridentate, with red hair at apex; clypeus convex, dull at sides, in middle polished, with scattered large punctures, the lower margin broadly and shallowly emarginate, with a small median tubercle; supraclypeal area in middle flattened, smooth, and polished; antennae entirely black; mesothorax dullish anteriorly, the posterior disk shining and punctured; anterior part of scutellum impunctate, but only moderately shining; tegulae clear ferruginous; wings hyaline, orange-tinted, the apical margin pale grayish; stigma and nervures ferruginous; spurs ferruginous; hind basitarsi broad.

Piches and Perene Valleys, Peru, 2,000–3,000 feet altitude (Soc. Geog. de Lima). This looks sufficiently like *M. flabellata* Vachal to raise the question whether it could be its female, but it is quite distinct by the shape of the marginal cell and other characters. In Schrottky's table of Brazilian *Megachile* this runs to *M. gracilis*, an entirely different insect with ferruginous legs.

Type.—Cat. No. 21690, U.S.N.M.

MEGACHILE LAQUEATA, new species.

Female.—Length about 11 mm., anterior wing 7.5; rather narrow and parallel-sided, black, the general effect of the scanty pubescence gray. Face, cheeks, and front with long clear white hair, clypeus with long black hair; vertex with scanty black hair; thorax with white hair, but disks of mesothorax and scutellum with scanty black hair, not easily observed; position of tubercles marked by a dense tuft of white hair; legs with white hair, clear ferruginous on inner side of tarsi; abdomen basally with thin dull white hair, apically with rather coarse black hair, first segment with a small patch of white hair on each side; segments 2 to 4 with narrow entire white hair-bands, the last tinged with ochreous; sixth segment with appressed pale and erect black hair; ventral scopa white, suffused with ochreous on fifth segment and base of sixth, but on sixth, except base, black. Mandibles broad, the two apical teeth prominent, marked at sides with ochreous hair, and also a line of ochreous hair parallel with broad cutting edge; clypeus short, densely rugosopunctate, the lower margin crenulate; flagellum very faintly reddish beneath; front and vertex minutely and closely punctured; mesothorax and scutellum dull, with small indistinct punctures; tegulae very dark brown; wings dusky, darker in region of marginal cell and apex; abdomen shining; spurs pale ferruginous; hind basitarsi not very broad.

Ecuador, from the C. F. Baker collection. Very like *M. peruviana* Smith, to which it runs best in Friese's table of species of Brazilian subregion; but if we may trust Smith's description it differs by the darker wings and scopa black at end. Among the species known from Ecuador, it is suggestive of *M. philinca* Cockerell; but that differs from *M. laqueata* by the conical abdomen, red legs, bright buffy hair surrounding mesothorax, red tegulae, etc.

Type.—Cat. No. 21691, U.S.N.M.

MEGACHILE CURVIPES Smith.

Male.—Sapucay, Paraguay, 3. 9. 1901.

MEGACHILE HOFFMANNSEGGIAE Jörgensen.

Female.—Carcarana, Argentina (Bruner 24).

MEGACHILE BURMEISTERI Friese.

Female.—Carcarana, Argentina (Bruner 25). Allied to the last, but easily known by the absence of any white hair band in scutello-mesothoracic suture, and the entirely black hair of sixth dorsal abdominal segment. The ventral scopa is not such a deep red; there are a few black hairs at apex.

NOTES ON THE WRENS OF THE GENUS NANNUS BILLBERG.

By Harry C. Oberholser,

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The wrens of the genus *Nannus*, from the standpoint of geographic distribution, form one of the most interesting groups of passerine birds. The present contribution to their elucidation is the result of an attempt to identify the specimens of this genus from Alaska contained in the collection of the Biological Survey in the United States National Museum. It finally became necessary to extend the investigation to most of the Old World forms as well as to all those from North America. For this purpose there have been available the specimens in the United States National Museum, including the collection of the Biological Survey, and a number of others kindly loaned by Mr. John E. Thayer, Mr. Outram Bangs, and Mr. A. C. Bent, to whom for this courtesy the writer wishes to extend his thanks. This material comprises 364 birds, including representatives of all the North American forms and most of those inhabiting the Old World, as well as the types of all the North American races excepting *Nannus hiemalis* (Vieillot).

The most important previous publications on this group are as follows:

Sharpe, R. Bowdler.—[Genus] *Anorthura.* Catalogue of the Birds in the British Museum, vol. 6, 1881, pp. 268–280, pl. 16.

Oberholser, Harry C.—Synopsis of the Genus commonly called *Anorthura.* Auk, vol. 19, No. 2, April, 1902, pp. 175–181.

Ridgway, Robert.—Genus *Olbiorchilus* Oberholser. Bulletin of the United States National Museum, No. 50, pt. 3, 1904, pp. 595–605.

Hartert, Ernst.—Gattung *Troglodytes* Vieill. Vögel der paläarktischen Fauna, vol. 1, Heft VI, June, 1910, pp. 776–784.

All measurements in the following pages are given in millimeters, and have been taken as explained in the writer's paper on *Butorides virescens.*[1] In this connection it might be well to mention that, by an unfortunate mistake, the measurements of the culmen given by

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[1] Proc. U. S. Nat. Mus., vol. 42, August 29, 1912, p. 533.

Mr. Ridgway in volume 3 and other early volumes of his Birds of North and Middle America,[1] are partly wrong, since some of the specimens were measured for total culmen and others for exposed culmen, but all averaged together. In other cases the measurement furnished is called exposed culmen, when it should be total culmen, or the reverse. The measurements hereinafter given for *Nannus troglodytes hiemalis* and *Nannus troglodytes pacificus* are taken from Ridgway's work, except for the culmen, which has been remeasured. The names of colors are based on Mr. Ridgway's recently published Color Standards and Color Nomenclature.

The genus *Nannus* Billberg[2] is by some authors merged with *Troglodytes* Vieillot, but it is undoubtedly sufficiently well marked to be treated as a separate group. It differs from *Troglodytes* in its short tail, which is less than three-fourths of the length of the wing; its slender and depressed bill, the culmen being almost straight; and in its narrow and silt-like nares, almost covered by overhanging membranes which are very slightly or not at all thickened.

The forms of this well circumscribed genus show a remarkable tendency to vary geographically, particularly on islands, and this has given rise to a large number of local races. There is, furthermore, a considerable amount of individual variation, although this is much more evident in some than in others. The seasonal difference is also in many cases great, as birds in the summer become much paler and less rufescent.

Until recently a number of the forms of *Nannus* were considered distinct species. The writer in 1902 reduced some of these to subspecies,[3] but still retained several specific groups. Several years later Doctor Hartert[4] treated all as races of a single species. This action the present writer, after a careful study of nearly all the forms of the genus, is now prepared to indorse. The North American birds alone have hitherto been referred to three distinct species, but it is evident from the following comparisons that they must all be considered subspecies of the Old World *Nannus troglodytes* (Linnaeus). Wide individual variation overlaps the difference between *Nannus hiemalis* of eastern North America and *Nannus troglodytes* of Europe. Intergradation of *Nannus hiemalis* with *Nannus hiemalis pacificus* is already understood; the latter intergrades individually with *Nannus fumigatus* of Japan, and this in the same manner with *Nannus nipalensis* of northern India. Baird's *Nannus alascensis* from the Pribilof Islands, Alaska, inosculates individually with *Nannus hiemalis helleri* of Kodiak Island, Alaska, which, in turn, clearly connects with *Nannus hiemalis* through *Nannus hiemalis pacificus.* Furthermore, *Nannus meligerus*, which the writer described as a distinct species, is now, by the acquisition of further material, found to be linked with *Nannus alascensis* and *Nannus hiemalis pacificus* through forms on the middle and eastern islands of the Aleutian Chain. There is thus no logical alternative but to consider all the known forms of the genus *Nannus* as subspecies of a single type, which will therefore be *Nannus troglodytes* (Linnaeus) as the earliest described form. Dr. E. Hartert has recently published an excellent revision of the Palaearctic forms of this genus,[1] and our present interest is therefore especially in the American birds. Notes on a few of the Old World species, however, may be pertinent in this connection.

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[1] Bull. U. S. Nat. Mus., No. 50.

[2] Synopsis Faunae Scand., vol. 1, pt. 2, 1828, Table A, and p. 57 (type, by monotypy, *Motacilla troglodytes* Linnaeus).

[3] Auk, vol. 19, 1902, pp. 177–180.

[4] Vögel paläarkt. Fauna, vol. 1, Heft VI, June, 1910, pp. 776–784.

Birds from Norway, with which I assume Swedish birds to be identical, and which therefore represent typical *Nannus troglodytes* (Linnaeus),[2] differ from those of middle Europe by reason of their somewhat darker, duller, less rufescent upper parts; darker, more ochraceous lower surface; and usually more distinct dark barring on the lower back and rump. The earliest name for the bird from central and southern Europe is *Troglodytes domesticus* Brehm,[3] but this is preoccupied by *Sylvia domestica* Wilson,[4] a synonym of *Troglodytes aedon* Vieillot. The next and proper name for this subspecies is *Troglodytes sylvestris* Brehm,[5] described from Germany, which therefore now should stand as *Nannus troglodytes sylvestris* (Brehm).

The bird heretofore known as *Troglodytes pallidus* Hume requires another name, since this *Troglodytes pallidus*[6] is preoccupied by *Troglodytes pallida* d'Orbigny,[7] which is a synonym of *Troglodytes musculus hornensis* Lesson. The earliest tenable name for *Troglodytes pallidus* Hume is therefore *Nannus tianschanicus* (Sharpe).[8]

The race described as *Olbiorchilus fumigatus amurensis* Clark,[9] from the Amur region, has been synonymized by Hartert[1] with *Olbiorchilus fumigatus peninsulae* Clark, but it is undoubtedly a good form, though, of course, but a subspecies. The bird named by Buturlin *Anorthura fumigata ussuriensis*,[2] from the Usuri region of eastern Siberia, is apparently the same.

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[1] Vögel paläarkt. Fauna, vol. 1, Heft VI, June, 1910, pp. 776–784.

[2] See Hartert, Vögel paläarkt. Fauna, vol. 1, Heft VI, June, 1910, p. 778.

[3] Handb. Naturg. Vögel Deutschlands, 1831, p. 454 (Germany).

[4] Amer. Ornith., vol. 1, 1808, p. 129, pl. 7, fig. 3.

[5] Handb. Naturg. Vögel Deutschlands, 1831, p. 455.

[6] *Troglodytes pallidus* Hume, Stray Feathers, vol. 3, Nos. 1–3, January, 1875, p. 219 (Kashgar).

[7] *Troglodytes pallida* d'Orbigny, Mag. de Zool., vol. 7, 1837, Cl. II, pls. 77–79, p. 25 (Rio Negro, Patagonia).

[8] *Troglodytes tianschanica* Sharpe, Cat. Birds Brit. Mus., vol. 6, 1891, p. 273, footnote (Severtzoff MSS.) (new name for *Troglodytes pallidus* Hume).

[9] Proc. U. S. Nat. Mus., vol. 32, June 15, 1907, p. 474 (Fusan, Korea).

A complete list of the 36 forms of this genus now recognizable, in what seems to be most nearly their natural order, is here added:

Nannus troglodytes troglodytes (Linnaeus).
Nannus troglodytes sylvestris (Brehm).
Nannus troglodytes hirtensis (Seebohm).
Nannus troglodytes borealis (Fischer).
Nannus troglodytes zetlandicus (Hartert).
Nannus troglodytes islandicus (Hartert).
Nannus troglodytes kabylorum (Hartert).
Nannus troglodytes cypriotes (Bate).
Nannus troglodytes zagrossiensis (Sarudny and Loudon).
Nannus troglodytes hyrcanus (Sarudny and Loudon).
Nannus troglodytes tianschanicus (Sharpe) (=*pallidus* Hume).
Nannus troglodytes magrathi (Whitehead).
Nannus troglodytes neglectus (Brooks).
Nannus troglodytes tibetanus (Walton).
Nannus troglodytes nipalensis (Blyth).
Nannus troglodytes talifuensis (Sharpe).
Nannus troglodytes taivanus (Hartert).
Nannus troglodytes szetschuanus (Hartert).
Nannus troglodytes dauricus (Dybowski and Taczanowski).
Nannus troglodytes tarbagataica (Suschkin).
Nannus troglodytes idius (Richmond).
Nannus troglodytes amurensis (Clark).
Nannus troglodytes peninsulae (Clark).
Nannus troglodytes fumigatus (Temminck).
Nannus troglodytes ogawae (Hartert).
Nannus troglodytes kurilensis (Stejneger).
Nannus troglodytes pallescens (Ridgway).
Nannus troglodytes meligerus (Oberholser).
Nannus troglodytes kiskensis Oberholser.[3]
Nannus troglodytes alascensis (Baird).
Nannus troglodytes tanagensis Oberholser.[3]
Nannus troglodytes petrophilus Oberholser.[3]
Nannus troglodytes semidiensis Brooks.

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[1] Vögel paläarkt. Fauna, vol. 1, Heft VI, June, 1910, p. 788.
[2] Messager Ornith., vol. 1, Heft II, 1910, p. 118.
[3] New subspecies; see the following pages.

Nannus troglodytes helleri (Osgood).
Nannus troglodytes pacificus (Baird).
Nannus troglodytes hiemalis (Vieillot).

Following is a detailed treatment of all the American subspecies:

NANNUS TROGLODYTES MELIGERUS (Oberholser).

Anorthura meligera Oberholser, Auk, vol. 17, No. 1, January, 1900, p. 25 (Attu Island, Alaska).

Subspecific characters.—Similar to *Nannus troglodytes pallescens* (Ridgway), from the Commander Islands, but upper parts darker; lower parts more deeply ochraceous, posteriorly less heavily barred with blackish.

Measurements.—Male:[1] wing, 53–55.5 (average, 53.9) mm.; tail, 33–37 (35.3); exposed culmen, 14–15.5 (14.6); tarsus, 19–20 (19.6); middle toe without claw, 13.5-15 (14.2).

Female:[2] wing, 50.5; tail, 33.5; exposed culmen, 14.5; tarsus, 19; middle toe without claw, 13.5.

Type-locality.—Attu Island, Aleutian Islands, Alaska.

Geographic distribution.—Attu Island, Aleutian Islands, Alaska.

Remarks.—This wren when first described was supposed to occupy all the Aleutian Islands west of Unalaska Island, but by additional material recently collected from the intervening islands it is now shown to be confined, so far as known, to Attu Island, although it probably will be found also on the near-by Agattu Island. Furthermore, as already indicated, it must be considered only a subspecies, since it is now known to intergrade with the forms occurring on Unalaska Island and the Pribilof Islands through the birds of the intervening Aleutian Chain. This is one of the most deeply colored of the North American forms and is apparently a well-differentiated race.

By some curious mistake the subspecific name of this bird was printed *meliger* in the last edition of the American Ornithologists' Union Check-List.[3] The term is taken from the Greek word μελιγηρυς, meaning musical, and was Latinized in feminine as *meligera*, or masculine *meligerus*.

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[1] Five specimens, from Attu Island, Alaska.
[2] One specimen, from Attu Island, Alaska.
[3] Committee American Ornith. Union, Check-List North Amer. Birds, ed. 3, 1910, p. 341.

Detailed measurements of specimens of this subspecies are as follows:

Measurements of specimens of Nannus troglodytes meligerus.

U.S.N.M. number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
201528[a]	Male....	Attul., Aleutian Is........	June 9, 1906	A. H. Clark...	53.0	33.0	14.0	19.0	14.0
201526[a]	...do.....	.....do.....................	June 11, 1906	.....do.........	53.5	35.5	.....	20.0	14.0
201527[a]	...do.....	.....do.....................	.....do.........	.....do.........	54.5	37.0	15.0	19.5	13.5
65479[a]	...do.....	.....do.....................	June 20, 1873	W. H. Dall....	53.0	34.0	15.5	20.0	15.0
135646[a]	...do.....	.....do.....................	June 4, 1894	C. H. Townsend.	55.5	37.0	14.0	19.5	14.5
135647[a]	Female .	.....do.[b]..................	.....do.........	.....do.........	50.5	33.5	14.5	19.0	13.5

[a] Used in measurement averages on p. 227. [b] Type.

NANNUS TROGLODYTES KISKENSIS, new subspecies.

Subspecific characters.—Similar to *Nannus troglodytes meligerus*, but wing, tail, and tarsus shorter; upper parts lighter, less rufescent (more grayish) brown, and posteriorly more uniform (less distinctly barred); lower parts more deeply ochraceous, and posteriorly somewhat less heavily barred with blackish.

Description.—Type, adult male, No. 230239, U.S.N.M., Biological Survey collection; Kiska Harbor, Kiska Island, Aleutian Islands, Alaska, June 19, 1911; A. Wetmore; original number, 559. Pileum olive brown, somewhat lighter on the forehead, where the worn feathers of the summer plumage have not yet been fully molted out; back between olive brown and buffy brown, posteriorly somewhat rufescent and with faint, darker bars; upper tail-coverts and tail Prout's brown, numerously barred with blackish brown, passing on the distal portion of the feathers into cinnamon buffy or sayal brown; wings fuscous, barred on the exterior portion of the outer webs of the feathers and on also the inner webs of the tertials with sayal brown and buffy; superciliary stripe pale buff; sides of head like the crown; sides of neck like the back, but with flecks of pale buff like the sides of the head; lower parts between cinnamon buff and avellaneous, the jugulum rather darker, more brownish, but flanks, sides, and crissum, between sayal brown and Saccardo's umber; sides, flanks, abdomen, and crissum spotted and irregularly barred with brownish black or blackish brown; lining of wing mixed buffy whitish and pale drab.

Measurements.—Male:[1] wing, 51–52 (average, 51.8) mm.; tail, 32–33.5 (32.9); exposed culmen, 14.5–16 (15.1); tarsus, 19; middle toe without claw, 14–14.5 (14.4).

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[1] Four specimens, from Kiska Island, Alaska.

Female:[1] wing, 48–49 (average, 48.4) mm.; tail, 27–32 (29.3); exposed culmen, 14–15 (14.3); tarsus, 18; middle toe without claw, 13.5–14.5 (13.9).

Type-locality.—Kiska Harbor, Kiska Island, Aleutian Islands, Alaska.

Geographic distribution.—Kiska Island and Little Kiska Island, Aleutian Islands, Alaska.

Remarks.—This race shows its subspecific relationship with *Nannus troglodytes meligerus* by its individual variation, which, in occasional specimens, practically bridges over the difference between it and the latter, though normal specimens are decidedly different. One example from Kiska Island (No. 65480, U.S.N.M.) is much more rufescent than the rest and shows a tendency toward intergradation with the bird from Unalaska Island.

Detailed measurements of examples of this race are given below:

Measurements of specimens of Nannus troglodytes kiskensis.

U.S.N.M. number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
230237[a]	Male....	Kiska Harbor, Kiska I., Alaska.	June 18, 1911	A. Wetmore..	52.0	33.5	14.5	19.0	14.5
230242[a]	...do.....	.....do.....................	.....do.........	.....do..........	52.0	32.0	15.5	19.0	14.5
230239[a]	...do.....	.....do.[b]	June 19, 1911	.....do..........	51.0	32.5	14.5	19.0	14.5
65480[a]	...do.....	.....do.....................	June 20, 1873	W. H. Dall....	52.0	33.5	16.0	19.0	14.0
230238[a]	Female .	.....do.....................	June 18, 1911	A. Wetmore...	48.5	30.0	15.0	18.0	14.0
230240[a]	...do.....	.....do.....................	.....do.........	.....do..........	48.0	27.0	14.0	18.0	14.5
230241[a]	...do.....	.....do.....................	.....do.........	.....do..........	49.0	28.0	14.0	18.0	13.5
230243[a]	...do.....	.....do.....................	June 19, 1911	.....do..........	48.0	32.0	14.0	18.0	13.5

[a] Used in measurement averages on pp. 228–229. [b] Type.

NANNUS TROGLODYTES ALASCENSIS (Baird).

Troglodytes alascensis BAIRD, Trans. Chicago Acad. Sci., vol. 1, pt. 2, 1869, p. 315, pl. 30, fig. 3.

Subspecific characters.—Similar to *Nannus troglodytes kiskensis*, but wing and tail longer; bill decidedly, tarsus and middle toe without claw somewhat, shorter; upper parts darker, more rufescent; lower parts rather more deeply ochraceous, and posteriorly with narrower, less deeply blackish bars.

Measurements.—Male:[2] wing, 53–55 (average, 54) mm.; tail, 32.5–35.5 (34); exposed culmen, 13–13.5 (13.3); tarsus, 18–18.5 (18.2); middle toe without claw, 13–14 (13.5).

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[1] Four specimens, from Kiska Island, Alaska.

[2] Four specimens, from the Pribilof Islands, Alaska.

Female:[1] wing, 50–54.5 (average, 51.7) mm.; tail, 30.5–33.5 (32.3); exposed culmen, 12–13.5 (12.9); tarsus, 17–18.5 (17.7); middle toe without claw, 12–13.5 (13).

Type-locality.—St. George Island, Pribilof Islands, Alaska.

Geographic distribution.—Pribilof Islands, Alaska.

Remarks.—This island race differs from *Nannus troglodytes meligerus* in its shorter culmen, tarsus, and middle toe; more rufescent upper parts; more uniform, less heavily barred posterior lower parts; and much more deeply ochraceous under surface. It was originally described from a very imperfect, immature example, and not until now could a satisfactory series of adult birds be had for comparison. This series shows that the bird from the Pribilof Islands, which must be true *Nannus troglodytes alascensis*, is subspecifically different from all the birds of the Aleutian Chain, including Unalaska Island. It appears to be confined to the islands of St. George and St. Paul in the Pribilof group.

Detailed measurements of adult specimens examined are as follows:

Measurements of specimens of Nannus troglodytes alascensis.

U. S. N. M. number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
237537[a]	Male....	St. Paul I., Pribilof Is., Alaska.	Oct. 29, 1914	G. D. Hanna..	55.0	34.0	.....	.....	.....
68324[a]	Male....	St. George I., Pribilof Is., Alaska.	....	G. R. Adams .	54.0	35.5	13.5	18.5	14.0
261531[a]	...do.....	.....do.....................	Dec. 25, 1913	G. D. Hanna .	53.0	32.5	13.0	18.0	13.5
261534[a]	...do.....	.....do.....................	Jan. 7, 1914	.....do.........	54.0	34.0	13.5	18.0	13.0
237539[a]	Female .	St. Paul I., Pribilof Is., Alaska.	May 16, 1915	.....do.........	50.0	32.0	13.5	18.5	12.0
261532[a]	..do......	St. George I., Pribilof Is., Alaska.	Dec. 25, 1913	.....do.........	52.0	33.5	12.0	17.0	13.0
261535[a]	..do......	.....do.....................	Jan. 7, 1914	.....do.........	54.5	33.0	12.5	18.5	13.5
261536[a]	..do......	.....do.....................	.....do........	.....do.........	51.0	30.5	13.5	17.5	13.0
261533[a]	..do......	.....do.....................	.....do........	.....do.........	51.0	32.5	13.0	17.0	13.5

[a] Used in measurement averages on pp. 229–230.

NANNUS TROGLODYTES TANAGENSIS, new subspecies.

Subspecific characters.—Similar to *Nannus troglodytes kiskensis*, but wing somewhat longer; upper parts more rufescent and rather lighter, especially on the lower back, rump, and upper tail-coverts; posterior lower parts on the average less heavily barred, and with the bars less blackish; the entire under surface averaging lighter and somewhat more ochraceous.

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[1] Five specimens, from the Pribilof Islands, Alaska.

Description.—Type, adult male, No. 230245, U.S.N.M., Biological Survey Collection; Tanaga Bay, Tanaga Island, Aleutian Islands, Alaska, June 25, 1911; A. Wetmore; original number, 607. Pileum dull olive brown, the forehead faded to a lighter shade; back Saccardo's umber; rump and upper tail-coverts between cinnamon brown and tawny, with obsolescent dark brown bars; tail basally of the same color as the rump, terminally sayal brown, paling in some places to buffy, and narrowly barred throughout with dark brown or blackish; wings fuscous, broadly barred on the outer webs of quills and coverts with sayal brown and buff; lores fuscous; broad postocular stripe dull olive brown; cheeks and sides of neck dull cinnamomeous, more or less mixed with fuscous; lower parts, including edge of wing, between cinnamon and cinnamon buff, paler on chin and medial portion of abdomen; flanks and sides sayal brown; abdomen, flanks, and crissum, spotted or irregularly barred with blackish brown or brownish black.

Measurements.—Male:[1] wing, 52–55 (average, 53.4) mm.; tail, 28.5–33.5 (32); exposed culmen, 14–16 (15.1); tarsus, 18–19.5 (18.8); middle toe without claw, 13–14.5 (14).

Female:[2] wing, 48.5–53.5 (average, 50.5) mm.; tail, 29–32 (31); exposed culmen, 15–15.5 (15.1); tarsus, 18–19.5 (18.4); middle toe without claw, 13–14 (13.7).

Type-locality.—Tanaga Bay, Tanaga Island, Aleutian Islands, Alaska.

Geographic distribution.—Islands of Tanaga, Adak, and Atka, in the Aleutian chain, Alaska, together with probably other intervening and adjoining islands.

Remarks.—This new race is similar to *Nannus troglodytes alascensis* from the Pribilof Islands, but its bill is much longer and its upper parts lighter. While intermediate between *Nannus troglodytes kiskensis* from Kiska Island and the bird occupying Unalaska Island, the present race is sufficiently different from both to necessitate subspecific distinction. It is, of all the races inhabiting the Aleutian Islands, the one nearest in characters to *Nannus troglodytes alascensis* of the Pribilof Islands.

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[1] Five specimens, from the Aleutian Islands of Tanaga, Adak, and Atka, Alaska.

[2] Four specimens, from Tanaga and Adak Islands, Alaska.

Measurements of individual specimens are as follows:

Measurements of specimens of Nannus troglodytes tanagensis.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 230245[a]	Male....	Tanaga Bay, Tanaga I., Aleutian Is., Alaska.[b]	June 25, 1911	A. Wetmore.	54.0	33.0	15.5	19.0	14.5
U.S.N.M. 230246[a]	...do.....	.....do............	.....do........	.....do.......	52.5	28.5	16.0	19.5	14.0
U.S.N.M. 230248[a]	...do.....	Bay of Waterfalls, Adak I., Aleutian Is., Alaska.	June 26, 1911	.....do.......	52.0	33.0	14.0	18.0	14.5
A. C. Bent 4818[a]	...do.....	Atka I., Aleutian Is., Alaska.	June 14, 1911	A. C. Bent..	55.0	.....	14.5	19.0	14.0
U.S.N.M. 131757[a]	...do.....	.....do.............	May 24, 1892	B. W. Evermann.	53.5	33.5	15.5	18.5	13.0
U.S.N.M. 230247[a]	Female .	Tanaga Bay, Tanaga I., Aleutian Is., Alaska.	June 25, 1911	A. Wetmore.	50.0	32.0	15.0	18.0	14.0
U.S.N.M. 230244[a]	...do.....	Bay of Waterfalls, Adak I., Aleutian Is., Alaska.	June 26, 1911	.....do.......	50.0	32.0	15.0	18.0	14.0
A. C. Bent 4819[a]	...do.....	.....do............	June 27, 1911	A. C. Bent..	53.5	.....	15.5	19.5	.....
A. C. Bent 4820[a]	...do.....	.....do............	.....do........	.....do.......	48.5	29.0	15.0	18.0	13.0

[a] Used in measurement averages on p. 231.

[b] Type.

NANNUS TROGLODYTES PETROPHILUS, new subspecies.

Subspecific characters.—Similar to *Nannus troglodytes alascensis*, but wing shorter; bill longer; upper parts lighter, much more rufescent; lower parts decidedly paler, and posteriorly with narrower and lighter bars.

Description.—Type, adult female, No. 167340, U.S.N.M., Biological Survey Collection; Unalaska, Unalaska Island, Alaska, October 23, 1900; W. H. Osgood; original number, 569. Crown slightly brownish Saccardo's umber; remainder of upper parts cinnamon brown, but more tawny on the rump; upper tail-coverts between tawny and cinnamon brown, and with scarcely perceptible darker bars; tail of the same color as the rump, barred conspicuously with brownish black; wings fuscous, the primaries barred with pale ochraceous buff, the remaining feathers, both quills and coverts, edged or barred with sayal brown; lores and postocular region fuscous; superciliary stripe buffy white; sides of neck like the back; cheeks mixed fuscous and pale cinnamon; lateral lower surface and the lower portion of the sides of the neck, pale cinnamomeous, between cinnamon and tawny olive; median lower parts much paler, between dull light pinkish cinnamon and pinkish buff; lower tail-coverts between tawny and cinnamon brown, and together with the abdomen and flanks, barred narrowly with brownish black; lining of wing pale buffy flecked with fuscous.

Measurements.—Male:[1] wing, 50–53 (average, 51.6) mm.; tail, 30–36 (32.9); exposed culmen, 12.5–15 (13.8); tarsus, 17.5–20 (18.6); middle toe without claw, 12.5–14.5 (13.7).

Female:[2] wing, 47–50 (average, 49.2) mm.; tail, 30–33 (31.5); exposed culmen, 12.5–13.5 (13); tarsus, 18–19 (18.3); middle toe without claw, 13–13.5 (13.3).

Type-locality.—Unalaska Island, Aleutian Islands, Alaska.

Geographic distribution.—Unalaska, Amaknak, and Akutan Islands in the Aleutian Islands, Alaska.

Remarks.—This new race may be readily distinguished from *Nannus troglodytes alascensis*, with which it has heretofore been considered identical, owing, of course, to the imperfect material available from the Pribilof Islands, the type-locality of the latter. The good series now at hand makes evident its excellent characters of both in size and color. It is, in fact, nearest to *Nannus troglodytes tanagensis*, from which it differs in its decidedly shorter bill; somewhat more abbreviated wing; more rufescent upper parts; and more deeply ochraceous lower surface. It is apparently confined to the islands of Unalaska, Amaknak, and Akutan.

Detailed measurements of adult specimens are as follows:

Measurements of specimens of Nannus troglodytes petrophilus.

U. S. N. M. number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
118876[3]	Male....	Unalaska I., Aleutian Is., Alaska.	Aug. 16, 1890	W. Palmer....	51.0	30.0	.....	18.0	14.0
170047[3]	...do....	.....do....................	July 15, 1899	R. Ridgway...	52.0	32.0	15.0	18.5	14.0
230236[3]	...do....	.....do....................	June 7, 1911	A. Wetmore...	51.5	33.0	13.5	18.0	14.0
78867[3]	...do....	.....do....................	Mar. 15, 1879	L. M. Turner..	53.0	31.5	14.0	18.0	14.0
78870[3]	...do....	.....do....................	....do........	....do.........	51.5	34.0	13.5	18.5	14.0
61635[3]	...do....	.....do....................	Dec. 3, 1871	W. H. Dall....	50.0	30.5	12.5	17.5	13.0
106653[3]	...do....	.....do....................	Oct. 19, 1885	C. H. Townsend.	51.5	34.5	13.0	19.5	14.0
61330[3]	...do....	.....do....................	Oct. 21, 1871	W. H. Dall....	52.0	34.5	15.0	19.0	14.5
61327[3]	...do....	Amaknak I., Aleutian Is., Alaska.	Oct. 22, 1871	....do.........	51.0	36.0	13.5	20.0	13.0
73508[3]	...do....	Akutan I., Aleutian Is., Alaska.	May 13, 1877	E. W. Nelson.	52.0	33.0	14.5	19.0	12.5
167339[3]	Female..	Unalaska I., Aleutian Is., Alaska.	Oct. 22, 1900	W. H. Osgood.	50.0	30.0	13.5	18.0	13.5
167340[3]	...do....	.....do.[4]...................	Oct. 23, 1900	....do.........	50.0	31.5	13.0	18.0	13.5
81340[3]	...do....	Iliuliuk I., Aleutian Is., Alaska.	Oct. 13, 1880	T. H. Bean....	47.5	33.0	12.5	19.0	13.0
106654	....	Unalaska, Unalaska I., Aleutian Is., Alaska.	Oct. 19, 1885	C. H. Townsend.	50.5	32.5	14.0	18.0	14.5
67820	....	.....do....................	May 14, 1874	L. M. Turner..	50.0	31.5	15.0	18.0	13.0

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[1] Ten specimens, from Unalaska, Amaknak, and Akutan Islands, Aleutian Islands, Alaska.

[2] Three specimens, from Unalaska Island, Alaska.

[3] Used in measurement averages on p. 233.

[4] Type.

NANNUS TROGLODYTES SEMIDIENSIS Brooks.

Nannus hiemalis semidiensis BROOKS, Bull. Mus. Comp. Zoöl., vol. 59, No. 5, September, 1915, p. 406 (Choyiet Island, Semidi Islands, Alaska.)

Subspecific characters.—Similar to *Nannus troglodytes petrophilus*, but wing, tail, and bill somewhat longer; upper parts less refuscent (more grayish) and somewhat darker; under surface paler, less deeply ochraceous, and posteriorly rather more heavily barred.

Measurements.—Male;[1] wing, 52.5–54 (average, 53.3) mm.; tail, 33–35 (34); exposed culmen, 15; tarsus, 18.5–19 (18.8); middle toe without claw, 14–14.5 (14.3).

Type-locality.—Choyiet Island, Semidi Islands, Alaska.

Geographic distribution.—Semidi Islands, Alaska.

Remarks.—This recently described race differs from *Nannus troglodytes alascensis* in its decidedly longer bill and somewhat longer tarsus and middle toe; somewhat lighter, less rufescent upper parts; and paler, less ochraceous lower surface. It is a distinct subspecies, nearest in characters to *Nannus troglodytes tanagensis*, but differing from this in somewhat less rufescent upper parts and paler lower surface, particularly on the posterior portion. It appears to be confined to the Semidi Islands; and the original specimens, of which the measurements are given below, are the only ones, so far as known, that exist in collections.

Measurements of specimens of Nannus troglodytes semidiensis.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm*	*mm.*	*mm.*	*mm.*
M. C. Z. 66711[a].	Male..	Choyiot I., Semidi Is., Alaska.[b]	Apr. 18, 1913	W. S. Brooks..	54.0	35.0	15.0	18.5	14.0
J. E. Thayer 3032.[a]	...do..	North Semidi I., Semidi Is., Alaska.	Apr. 19, 1913	J. Dixon......	52.5	33.0	15.0	19.0	14.5

[a] Used in measurement averages on p. 234. [b] Type.

NANNUS TROGLODYTES HELLERI (Osgood).

Anorthura hiemalis helleri OSGOOD, Auk, vol. 18, No. 2, April, 1901, p. 181 (English Bay, near Kodiak, Kodiak Island, Alaska).

Subspecific characters.—Similar to *Nannus troglodytes petrophilus*, but smaller, especially the bill; upper surface much darker, more sooty (less rufescent); dark bars of lower back, rump, and upper tail-coverts more conspicuous; lower parts darker, and posteriorly more heavily dark-barred.

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[1] Two specimens, from the Semidi Islands, Alaska.

Measurements.—Male:[1] wing, 49–49.5 (average, 49.3) mm.; tail, 30.5–32 (31.3); exposed culmen, 11.5; tarsus, 16.5–17.5 (17); middle toe without claw, 12.

Type-locality.—English Bay, near Kodiak, Kodiak Island, Alaska.

Geographic distribution.—Kodiak Island.

Remarks.—This island race is similar to *Nannus troglodytes alascensis*, but is smaller throughout; slightly more rufescent on the upper surface, the dark bars on the posterior portion being more conspicuous; and it averages darker below. With the better material of *Nannus troglodytes alascensis* now available, it is readily seen that the present race intergrades with that form by individual variation. Very few specimens of the present race exist in collections, and it thus is still one of the rarest American forms of the genus.

Detailed measurements are as follows:

Measurements of specimens of Nannus troglodytes helleri.

U.S.N.M. number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
167276[a]	Male....	English Bay, near Kodiak, Kodiak Island, Alaska.[b]	Oct. 3, 1900	W. H. Osgood.	49.0	32.0	11.5	17.5	12.0
167346[a]	Male....	Kodiak, Kodiak I., Alaska.	Oct. 4, 1900	.....do.........	49.5	30.5	11.5	16.5	12.0
54446	....	.....do.....................	Aug. 14, 1868	F. Bischoff....	45.5	28.0	11.5	17.0	13.0
115794	....	.....do.....................	Aug. 15, 1888	C. H. Townsend.	47.0	30.5	11.5	17.5	12.5

[a] Used in measurement averages on p. 235. [b] Type.

NANNUS TROGLODYTES PACIFICUS (Baird).

Troglodytes hyemalis var. *pacificus* BAIRD, Rev. Amer. Birds, vol. 1, 1864, p. 145 (Puget Sound).

Subspecific characters.—Similar to *Nannus troglodytes helleri*, but smaller, except feet, which are larger; and coloration brighter.

Measurements.—Male:[2] wing, 44–49.5 (average, 46.5) mm.; tail, 28–33.5 (30.3); exposed culmen, 10–11.3 (10.6); tarsus, 17–19.5 (18); middle toe without claw, 11.5–13.5 (12.8).

Female:[3] wing, 43.5–47.5 (average, 45.4) mm.; tail, 28–31 (29.7); exposed culmen, 10–10.9 (10.4); tarsus, 17–18.5 (17.9); middle toe without claw, 11.5–13.5 (12.5).

Type-locality.—Simiahmoo, Puget Sound, Washington.

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[1] Two specimens, from Kodiak Islands, Alaska.

[2] Ten specimens, from the western United States, British Colombia, and southeastern Alaska.

[3] Ten specimens, from the western United States.

Geographic distribution.—Western North America. Breeds north to western Alberta, northern British Columbia, and Prince William Sound, Alaska; west to the Pacific coast of southeastern Alaska, British Columbia, Washington, and California; south to central California, central Oregon, and southern Idaho; and east to western Montana and western Alberta. Winters south to southern California, southern Arizona, and southern New Mexico.

NANNUS TROGLODYTES HIEMALIS (Vieillot).

Troglodytes hiemalis Vieillot, Nouv. Dict. d'Hist. Nat., vol. 34, 1819, p. 514 (Nova Scotia and New York).

Troglodytes parvulus, var. *americanus* Naumann, Naturg. Vög. Deutschl., vol. 3, 1823, p. 724 (table).

Subspecific characters.—Similar to *Nannus troglodytes pacificus*, but paler above, and posteriorly more distinctly barred; lower parts also much paler and duller.

Measurements.—Male:[1] wing, 45–50 (average, 47.6) mm.; tail, 28–32 (30.3); exposed culmen, 10–11.2 (10.7); tarsus, 18–19.5 (18.5); middle toe without claw, 12–13 (12.8).

Female:[2] wing, 40–47 (average, 44.8) mm.; tail, 25–30 (27.8); exposed culmen, 10.1–11.2 (10.7); tarsus, 17–18.5 (17.8); middle toe without claw, 11–13 (12).

Type-locality.—Nova Scotia.[3]

Geographic distribution.—Eastern United States and southeastern Canada. Breeds north to Newfoundland, central Quebec, northern Ontario, southern Manitoba, and central Alberta; west to central Alberta; south to central Minnesota, northern Wisconsin, central Michigan, southern Ontario, Massachusetts, and along the Allegheny Mountains to southwestern North Carolina; east to the Allegheny Mountains in North Carolina and Pennsylvania, to Massachusetts, and the Atlantic coast from Maine to Newfoundland. Winters from the northern part of the eastern United States, south to Texas, Louisiana, Alabama, and northern Florida. Casual west to Colorado.

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[1] Ten specimens, from Maryland and the District of Columbia.

[2] Nine specimens, from Massachusetts, New York, Maryland, New Jersey, Illinois, and the District of Columbia.

[3] Designated by Oberholser, Auk, vol. 19, No. 2, April, 1902, p. 178.

ADDITIONS AND CORRECTIONS TO "THE TYPE-SPECIES OF THE GENERA OF THE CYNIPOIDEA OR THE GALL WASPS AND PARASITIC CYNIPOIDS."

By S. A. Rohwer and Margaret M. Fagan,
Bureau of Entomology, United States Department of Agriculture.

INTRODUCTION.

In the paper on The Type Species of the Genera of the Cynipoidea, or the Gall Wasps and Parasitic Cynipoids, published in the Proceedings of the U. S. National Museum,[1] there are several omissions and errors requiring correction.

These corrections, which were called to our attention by the kindness of Mr. L. H. Weld, include the addition of a few generic names, several overlooked type designations, and corrections of dates, page references, and orthography.

In the case of the page references for the genotypes transferred by Dalla Torre and Kieffer to other genera, the pages quoted in the paper refer to the page of the synonymy of the genus and not to the page of the transfer of the type-species.

CORRECTIONS.

Page 360:

Allocynips Kieffer. Correct reference is:

Phil. Journ. Sci., vol. 9, sec. D, 1914, p. 185.

Page 362:

Aulacidea Ashmead. Change " Present designation " to Original designation.

Auloxysta should read:

Auloxysta Thomson = (**Bothrioxysta** Kieffer).

Opusc. Entom., P. 8, 1887, p. 811. Seven species.

Type.—*Auloxysta nigripes* Thomson (Designated by Ashmead, 1903, p. 142.)

[Type.—*Auloxysta stricta* Thomson. (Rohwer and Fagan 1917.)]

Isogenotypic with *Bothrioxysta* Kieffer. Genotype placed in *Phaenoglyphis* Förster by Dalla Torre and Kieffer, 1910, p. 294.

Belenocnema should be:

Belonocnema. Both spellings occurred in the original discussion of the genus, but inasmuch as Mayr himself pointed out the error of the spelling Belenocnema it is better to use *Belonocnema.*

Bothrioxysta should read:

(**Bothrioxysta** Kieffer) = **Auloxysta** Thomson.

Bull. Soc. Hist. Nat. Metz (2), vol. 10, 1902, p. 11.

Type.—Auloxysta nigripes Thomson. (Rohwer and Fagan, 1917.)

Isogenotypic with *Auloxysta* Thomson. Genotype placed in *Phaenoglyphis* by Dalla Torre and Kieffer, 1910, p. 294.

---

[1] Vol. 53, June 6, 1917, pp. 357–380.

Page 363:

Charips. Add to first line:

=(**Xystus** HARTIG, not SCHÖNHERR).

After *Charips* insert:

Charipsella BRÈTHES.

Rev. Chilena Hist. Nat., vol. 17, 1913, pp. 159–160.

Bol. Mus. Nac. Chile, vol. 5, 1913, p. 200.

Type.—*Charipsella laevigata* Brèthes. (Original designation and monobasic).

The same article was published in two places. Which has priority can not at present be determined.

Cliditoma FÖRSTER should be (**Clidotoma** FÖRSTER), emendation for **Kleidotoma** WESTWOOD.

After *Compsodryoxenus* insert:

Conaspicera HEDICKE.

Nyt Mag. Naturvidensk., Kristiania, vol. 52, 1914, p. 353.

Type.—*Conaspicera norvegica* Hedicke. (Original designation and monobasic.

(**Conaspidia** HEDICKE, not KONOW, 1898) =**Cynoconaspidia,** new name.

Deutsch. Ent. Zeitschr., 1914, p. 635.

Type.—*Conaspidia neotropica* Hedicke. (Original designation and monobasic. This name was proposed by Konow in 1898 for a genus in the *Tenthredinoidea.*

Page 364:

After (Cynips Authors) insert:

Cynoconaspidia, new name=(**Conaspidia** HEDICKE, not KONOW, 1898).

Type.—*Conaspidia neotropica* Hedicke. (A new name takes same type.)

Page 366:

Dryorrhizoxenus ASHMEAD should be **Dryorhizoxenus.** Also correct *Belenocnema* to *Belonocnema.*

Page 367:

Eucoela WESTWOOD should be **Eucoila** WESTWOOD.

After *Eucoilidea* insert:

Eugonaspis HEDICKE.

Deutsch. Ent. Zeitschr., 1914, p. 637.

Type.—*Eugonaspis surinamensis* Hedicke. (Original designation and monobasic.)

Glauraspidia. In last sentence change **Aspistophyza** to **Apistophyza.**

Glyptoxysta. Insert after reference:

Type.—*Glyptoxysta heterocera* Thomson. (Designated by Ashmead, 1903, p. 142.)

[*Glyptoxysta xanthocephala* Thomson. (Rohwer and Fagan, 1917).]

Page 368:

Gonieucoela Kieffer. Page reference should be p. 112.

Insert after *Gronotoma:*

Hartigia RONDANI not (SCHIØDTE, 1838), BOIE, 1855, not ROBINEAU-DESVOIDY, 1863)=(**Teras** HARTIG, not TREITSCHKE)=**Dryoteras** FÖRSTER.

Bol. Soc. Ent. Ital., vol. 3, 1871, p. 232, footnote.

Type.—*Teras terminalis* Fabricius. (A new name takes same type.) Isogenotypic with *Teras* Hartig and *Dryoteras* Förster.

Heterobius. Change vol. 18 to vol. 17.

Page 371:

Megapelmus. Change page reference for Dalla Torre and Kieffer, 1910, from 38 to 35.

Melanips. After reference insert:

Scytodes opacus Hartig. (Designated by Förster, 1869, p. 367.)

[*Cynips urticae* Kirby. (Designated by Westwood, 1840, Syn., p. 56.); *Figites urticeti* Dahlbom (designated by Ashmead, 1903, p. 9.)]

The *Cynips urticae* included by Westwood in 1840 was *nomen nudum* and can not affect the status of the genus. Apparently the species which Westwood considered as Kirby's *urticae* is the same as *urticeti* Dahlbom, the only species included by Thomson (1861) in *Melanips.*

After *Moneucoela* insert:

Myrtopsen Rübsaamen.

Marcellia, vol. 6, 1907, p. 136.

Type.—*Myrtopsen mayri* Rübsaamen. (Monobasic.)

Neuroterus. Change:

(Designated by Beutenmüller, 1910) to

(Designated by Ashmead, 1903, p. 151).

Page 372:

Onychia. Add parenthesis:

(**Onychia** (Haliday) Westwood, not Hübner, 1816.)

Insert:

[Type.—*Onychia notata* Fonscolombe. (Designated by Förster, 1869, p. 362.) Type.—*Callaspidia fonscolombei* Dahlbom. (Designated by Ashmead, 1903, p. 11.)]

After *Onychia* insert:

(**Pantelia** Kieffer, not Bolivar, 1887)=**Panteliella** Kieffer.

André, Spec. Hym. Eur. Algeria, vol. 7, bis 1, p. 248.

Type.—*Aulax fedtschenkoi* (Rübsaamen). (Monobasic.)

Panteliella Kieffer=(**Pantelia** Kieffer, not Bolivar, 1887. Change date from 1902 to 1899.

Paraulax. Add, on line below reference:

Rev. Chilena Hist. Nat., vol. 8, 1904, p. 43.

The descriptions are identical in both articles, and it is impossible to determine which has priority.

Page 374:

Pseudeucoila. Add: Genotype placed in *Psilodora* by Dalla Torre and Kieffer, 1910, p. 195.

Psilogaster. Correct *anthyomyiarum* Hartig to *anthomyiarum* Bouché.

Page 375:

After *Sagaris* insert:

Salpictes Kieffer.

Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale (1911–12), Hym., vol. 1, 1913, p. 31.

Type.—*Salpictes rufiventris* Kieffer. (Original designation and monobasic.)

Scytodes. Add: Isogenotypic with *Melanips* (Walker) Giraud.

Page 376:

Synergus. Add: [*Synergus nigripes* Hartig. (Designated by Ashmead, 1903, p. 145.)]

Tetrarhoptra. Change *Cliditoma heterotoma* Thomson to (*Clidotoma*) *Kleidotoma heterotoma* Thomson.

Page 376—Continued.

Tetratoma should read:

Tetratoma Cameron (not **Fabricius**).

Monogr. Brit, Phytoph. Hym., vol. 3, 1890, p. 223. Four species.

Type.—*Kleiditoma tetratoma* Thomson. (Present designation.) (*Kleiditoma heterotoma* Thomson, designated by Rohwer and Fagan, 1917, not originally included.)

Genotype in *Tetrarhoptra* by Dalla Torre and Kieffer, 1919, p. 214.

Page 378:

Xystus should read:

(**Xystus Hartig**, not **Schönherr**, 1826) = (**Allotria Westwood**) = **Charips Haliday**, Zeitschr. f. Entom., vol. 2 (1839) 1840, p. 186. Ten species.

Type.—(*Xystus erythrocephalus* Hartig.) (Rohwer and Fagan, 1917) = *Allotria victrix* Westwood, teste Dalla Torre and Kieffer, 1910, p. 285.

Isogenotypic through synonymy with *Allotria* Westwood. Genotype placed in *Charips* by Dalla Torre and Kieffer, 1910, p. 267.

Zygosis should read ,after reference:

Type.—*Figites urticeti* Dahlbom (error in name) = *Psilogaster heteropterus* Hartig. (Original designation.)

Note.—This name was proposed for Dahlbom's subdivision II of the genus *Figites*. This is clear from the reference given by Förster. The mentioning of *urticeti* as type, is, as Dalla Torre and Kieffer (Das Tierreich, 1910, p. 81) point out, a typographical error. In the synonymy given by Förster the first valid name is *heteropterus* Hartig, which must be chosen as the valid type of *Zygosis* Förster. This agrees with Dalla Torre and Kieffer's interpretation.

Page 379:

After *fasciatipennis* add: fedtschenkoi Rübsaamen, (Aulax) Pantelia.

After *fonscolombei* add: fonscolombei Dahlbom, (Callaspidia) Onychia.

After *heptatoma* add: heterocera Thomson, Glyptoxysta.

After *kollari* add: laevigata Brèthes, Charipsella.

Page 380:

After *marianii* Kieffer, (Callirhytis) Fioriella add: mayri Rübsaamen, Myrtopsen.

After *nebulosa* add:

neotropica Hedicke, Conaspidia.

neotropica Hedicke, (Conaspidia) Cynoconaspidia.

After *nigrifemora* add:

nigripes Hartig, Synergus.

nigripes Thomson, Auloxysta.

After *noricus* add:

norvegica Hedicke, Conaspicera.

notata Fonscolombe, Onychia.

After *rufiventris* Giraud add: rufiventris Kieffer, Salpictes.

After *sulcata* add: surinamensis Hedicke, Eugonaspis.

After *terminalis* Fabricius, (Cynips) Dryoteras add: terminalis Fabricius, (Cynips) Hartigia.

After *tetratoma* Thomson, (Clidotoma) Tetrarhoptra add: tetratoma Thomson, (Clidotoma) Tetratoma.

After *unicarinata* add: urticae Kirby, (Cynips) Melanips.

After *urticarum* add: urticeti Dahlbom, (Figites) Diceraea.
Melanips.
Zygosis.

THE BRANCHIOBDELLID WORMS IN THE COLLECTIONS OF THE UNITED STATES NATIONAL MUSEUM, WITH DESCRIPTIONS OF NEW GENERA AND NEW SPECIES.

By **Max M. Ellis**,
Of the University of Colorado, Boulder, Colorado.

The Branchiobdellid worms discussed in this paper include those in the United States National Museum collection and worms from various localities, obtained in many cases through the personal efforts of various collectors. It is a pleasure to thank these collectors and credit the specimens to them under the proper species. The writer is indebted particularly to the United States National Museum for the loan of specimens; to Prof. J. Percy Moore, of the University of Pennsylvania, for valuable material for comparison; to Prof. Frank Smith, of the University of Illinois, for various favors in connection with this work; and to Dr. Walter Faxon, of Harvard University, for the determination of many of the host species of crayfish.

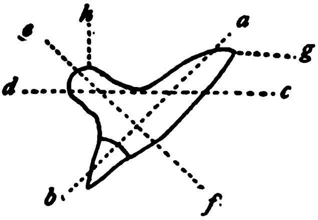

FIG. 1.—SAGITTAL SECTION THROUGH A TOOTH OF THE "B" ORDER OF THE UPPER JAW OF XIRONOGITON OREGONENSIS OREGONENSIS ELLIS FROM EUGENE, OREGON. PORTION BELOW AB—ANTERIOR FACE, PORTION ABOVE DC—SUPPORTING FACE, PORTION BELOW EF—DENTAL FACE, G—BASE OF JAW, H—DENTAL RIDGE.

In studying these worms special attention was given to the jaw characters and to the variation in the number of teeth. A sagittal section of either jaw is roughly triangular in outline, so that the jaw may be considered as having three faces. These have been termed the supporting face (fig. 1, portion above *dc*), the anterior face (portion below *ab*), and the dental face (portion below *ef*). When the jaw is in place the supporting face and a considerable portion of the dental face are imbedded in the wall of the pharynx, the teeth are directed caudad down the pharynx, and the anterior face lies parallel to the long axis of the body in the lumen of the pharynx. When the jaw is in use the teeth and part of the dental face are swung into the lumen of the pharynx by a movement of the entire jaw. Of these three faces of the jaw, the anterior is the most regular. The anterior or cephalic margin of the supporting face has been designated the base of the jaw (*g*) and the posterior or caudal

PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 55—NO. 2267.

margin the dental ridge (*h*). Unless otherwise specified, the outline drawings of the jaws show the jaw lying on its anterior face—that is, as if viewed from point *e* in figure 1. In this view the entire dental ridge (fig. 2, *h–h*) and the base of the jaw (*g*) may be seen. The dental ridge is usually sinuous in outline, following the bases of the several teeth. The base of the jaw may be regular or deeply emarginate.

In some species of the genus *Cambarincola* the posterior portion of the dental face (fig. 1, *d e*) may be produced caudad in large specimens so that it extends beyond the level of the longest tooth in the jaw, if the jaw is viewed from point *e*. If viewed from the anterior face (point *f*), this produced portion of the dental face forms a hood over the teeth and may be seen lying behind them. In figure 17 a small hood of this sort is shown, although this jaw is viewed from the hood side.

In all of the species examined the jaws, and the dental face in particular, were more or less arcuate. In measuring the jaws this fact should be remembered, as the teeth do not lie in a single plane and the jaw may be perceptibly flattened and thereby widened in an effort to force the teeth into one focal plane.

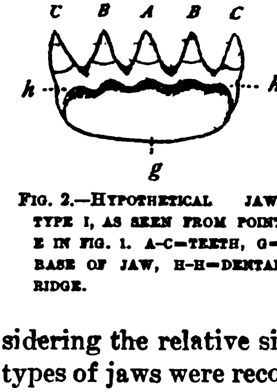

FIG. 2.—HYPOTHETICAL JAW, TYPE I, AS SEEN FROM POINT E IN FIG. 1. A-C—TEETH, G—BASE OF JAW, H-H—DENTAL RIDGE.

The dentition of the jaws has been expressed by two numbers, the first in each case referring to the number of teeth, regardless of size or shape, on the dorsal or upper jaw, and the second to the number of teeth on the ventral or lower jaw. Considering the relative size and position of the teeth on the jaw several types of jaws were recognized, each of which has been designated by a roman numeral. The primitive type of jaw seems to be one with several, subequal teeth (fig. 2). The modifications of this type have progressed along either or both of two lines, (1) a reduction in number of teeth, and (2) an increase in the size of certain teeth correlated with the reduction in size of certain other teeth. As the arrangement of the teeth on each jaw in species regularly having a dental formula of 5–5 or less could be interpreted in terms of a 5-toothed jaw, the teeth of which are symmetrically placed with reference to the median axis of the jaw, the 5-toothed jaw was chosen as a standard for the description of jaws. Considering the 5-toothed jaw as typical, its teeth have been lettered *C-B-A-B-C* (fig. 2). Capital letters have been used when the teeth were subequal and both capital and small letters when the teeth varied in length, long teeth being denoted by capitals. In the jaws bearing more than five teeth in the occasional individuals of species regularly having a dental formula of 5–5 or less, the extra tooth or teeth were placed asymmetrically, the five principal teeth following the 5-toothed jaw plan. Jaws of species having a dental formula of 6–6 or more approached the primitive jaw type, especially as the teeth of 6–6 and 7–6 jaws were usually more or less subequal. Among the species studied those having such dental formulae possessed other primitive characters. It was also found that the ventral jaw usually bore a smaller number of teeth than the upper, if both jaws did not carry the same number of teeth. For this reason the upper jaw was selected for purposes of comparison when but one jaw was used.

From the sections studied the number and position of the major pharyngeal diverticula and the presence or absence of buttress-like supports of connective tissue attached to the intersegmental partitions were considered to taxonomic value. The major pharyngeal diverticula may be seen to best advantage in sagittal sections (pl. 10, fig. 2), although they may be located in good whole mounts of compressed worms. These pharyngeal diverticula are not to be confused with the slight invaginations of the pharyngeal wall, nor with a fold in the pharyngeal wall near the posterior end of the pharynx (found in many preserved specimens), due to the pushing forward of the esophageal portion of the alimentary canal so that the anterior end of the esophagus partly telescopes the posterior end of the pharynx.

The buttress-like supports of the intersegmental partitions are found easily, if they are present in the specimen, in cross-sections (pl. 10, fig. 1). The supports extend from the lateral portions of the intersegmental partitions like braces, and lie more or less parallel to the long axis of the body, so that in certain cross-sections they appear to divide the cavity of the segment into three or more compartments.

XIRONODRILUS, new genus.

Branchiobdellid worms having: Two pairs of testes, one pair in segment V and one pair in segment VI, each nephridium of the anterior pair opening to the outside through a separate pore in the dorsal half of segment III; spermatheca simple, not bifid; no accessory sperm tube; three major pharyngeal diverticula, two dorsal and one ventral; the intersegmental septa in the posterior half of the body with butress-like supports more or less well developed; segments I to IX, inclusive, distinct, each segment being slightly constricted anteriorly and posteriorly, so that its junctions with the adjoining segments are well defined; at least nine distinct segments visible in a dorsal view; the alimentary canal straight, its maximum enlargement in segments III and IV; a somewhat concave, glandular adhesive disk near each lateral margin of the ventral surface of segments VIII and IX; the anal opening dorsal or dorso-terminal; the caudal sucker ventral; and the body distinctly depressed.

Type-species.—*Xironodrilus formosus*, new species.

This genus as here defined includes two species which may be distinguished by the following key.

*a*¹. Middle tooth of the upper jaw the longest tooth on the jaw if the teeth are odd in number; middle pair of teeth of the upper jaw subequal and longer than the other teeth, if the teeth are even in number; teeth increasing rather regularly in size from the outer edges of the jaw to the middle of the jaw; dental formula 5–4, varying from 4–3 to 6–5. *X. formosus*, new species.

*a*². Middle tooth of the upper jaw distinctly shorter than either of the two teeth adjoining the middle tooth; dental formula 4–4 or 5–4, varying from 3–3 to 5–5. *X. pulcherrimus* (Moore).

XIRONODRILUS FORMOSUS, new species.

Plate 11, fig. 2.

Type.—Cat. No. 17626, U.S.N.M., body length 2.7 mm., White River, Irondale, near Anderson, Indiana, August, 1915 (M. M. Ellis), on *Cambarus rusticus* Girard (det. Faxon).

Paratypes.—Ten, Cat. No. 17627, U.S.N.M., and 10 others, collected with the type.

Additional specimens.—500, White River, Irondale, near Anderson, Indiana, summers of 1914–16 (M. M. Ellis), on *Cambarus rusticus* Girard (det. Faxon); six, one=Cat. No. 17628, U.S.N.M., White River, Noblesville, Indiana, June 23, 1915 (M. M. Ellis), on *Cambarus rusticus* Girard; three, Lake Michigan, Charlevoix, Michigan, August 12, 1914 (M. M. Ellis), on *Cambarus propinquus* Girard (det. Faxon); three, Wabash River, Vincennes, Indiana, August, 1913 (M. M. Ellis), on *Cambarus propinquus* Girard; one, between Paoli and Wyandotte, Indiana (O. P. Hay), on *Cambarus rusticus* Girard, Cat. No. 17629, U.S.N.M.

Description.—Body rather elongate and distinctly depressed; width of the head approximately equal to that of segment I and less than that of segment II; body segments increasing in width regularly from segment I to segment VII; segment VII usually the widest segment of the body (in strongly contracted specimens and in specimens in which segment VII is not distended with sex cells, segments VII and VIII are usually about the same width, or segment VIII may be slightly wider than segment VII); nine body segments distinct and easily seen in the dorsal view; each segment slightly constricted anteriorly and posteriorly so that the junctions of the segments are evident; segments narrowing regularly and rapidly from the middle of segment VIII to the caudal sucker; diameter of caudal sucker less than or barely equal to the width of the head; head subcylindrical, its anterior third defined by a groove or constriction; lips two, the upper slightly longer than the lower; both upper and lower lips with small but rather definite median emargination, otherwise entire; margins of the lips bearing a few short, transparent bristles; tooth formula usually 5–4 or 5–5, varying from 4–3 to 6–5; upper jaw usually type V, lower jaw type V or type VI; tooth plan of both jaws *c-B-A-B-c*, upper jaw sometimes *c-B-A-B-c-d;* width of lower jaw 24 micra (in worm 1.4 mm. body length) to 30 micra (in worm 2.8 mm. body length); major pharyngeal diverticula three, two dorsal and one ventral, the ventral diverticulum about midway between the levels of the two dorsal diverticula; anterior nephridia alternating in segments II and III (of 44 specimens examined on this point 25 had the nephridium in segment II on the right side and that in segment III on the left; 17 had the nephridium in segment II on the left side and that in segment III on the right; and two individuals had both nephridia in segment II); anterior nephridia opening to the outside through separate pores on the dorsolateral surface of segment III; spermatheca in segment V, composed of three parts, a short muscular portion near the spermathecal pore, a middle tubular portion and a dorsoposterior, globose portion; testes in segments V and VI; vasa deferentia from segments V and VI joining the atrium in segment VI; no accessory sperm tube; alimentary canal straight, passing through the body near or along the mesial axis, somewhat expanded in segments I and II, strongly sacculated in segments III and IV, much narrowed in segments V and VI, slightly expanded in segment VII, narrowing from segment VII to the anal opening on the dorsal surface of the anterior half of segment X (in surface view the anus appears to open in the posterior half of segment IX, but sagittal sections show that the anal opening is between segments IX and X and that the rectal portion of the alimentary canal is carried by segment X); caudal sucker ventral; smallest specimen examined 0.8 mm. in length; largest 3.1 mm. (preserved specimens).

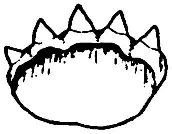

FIG. 3.—UPPER JAW OF TYPE-SPECIMEN OF XIRONODRILUS FORMOSUS ELLIS, FROM ANDERSON, INDIANA. TYPE V.

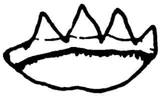

FIG. 4.—LOWER JAW OF TYPE-SPECIMEN OF XIRONODRILUS FORMOSUS ELLIS, FROM ANDERSON, INDIANA. TYPE VI.

A summary of the variations found in the number of teeth in this species is given below:

TABLE 1.

Locality.	Dental formulae.					
	4–3	4–4	5–4	5–5	6–5	7–5
Irondale, Anderson, Indiana	3	4	17	13	4	1
Noblesville, Indiana	1	1	4			
Charlevoix, Michigan			1		2	
Vincennes, Indiana			2	1		
Number of specimens, 54	4	5	24	14	6	1

XIRONODRILUS PULCHERRIMUS (Moore).

Plate 13, fig. 2.

Branchiobdella pulcherrima MOORE, Proc. Acad. Nat. Sci. Phila., vol. 45, pp. 423–425, pl. 12, figs. 2*a*, 2*b*, 2*c*, and 2*e*, 1893 (Wautauga County, North Carolina, on *Cambarus bartonii*).—SMALLWOOD, Biol. Bull., vol. 11, No. 2, pp. 100 and 106, fig. 2, 1906 (Lake Clear, Harrietstown, Franklin County, New York).

Specimens.—Five (3=Cat. No. 17630, U.S.N.M.), Trubies Run, a tributary of Buckhannon River, 7 miles above Buckhannon, West Virginia, August 4, 1899 (U. S. F. C.), on *Cambarus obscurus* Hagen; five (Cat. No. 17631, U.S.N.M.), Right Hand Fork of Chenowith Creek, Queens, West Virginia (U. S. F. C.), on *Cambarus obscurus* Hagen; two (1=Cat. No. 17632, U.S.N.M.), Shavers Fork, of Cheat River, West Virginia (U. S. F. C.), on *Cambarus bartonii carinirostris* Hay; one (Cat. No. 17633, U.S.N.M.), Cheat River, near the Pike, West Virginia, July 25, 1899 (U. S. F. C.), on *Cambarus bartonii carinirostris* Hay; three (2=Cat. No. 17634, U.S.N.M.), Cheat Bridge, Randolph County, West Virginia, July 24, 1899 (U. S. F. C.), on *Cambarus bartonii carinirostris* Hay; eight (6=Cat. No. 17635, U.S.N.M.), Chenowith Creek, between Beverly and Elkins, West Virginia, July 4, 1899 (U. S. F. C.), on *Cambarus bartonii carinirostris* Hay; eight (6=Cat. No. 17637, U.S.N.M.), Laurel Fork, Cheat River, near Seneca Point, West Virginia, August 31, 1899, on *Cambarus bartonii carinirostris* Hay; one (Cat. No. 17636, U.S.N.M.), Indian Creek, Kanawha County, West Virginia, August 6, 1900, on *Cambarus bartonii veteranus* Faxon; one, near Baileyville, West Virginia, August 15, 1900, on *Cambarus dubius* Faxon; two, Blowing Rock, Wautauga County, North Carolina, 1893 (J. P. Moore), on *Cambarus bartonii* (Fabricius); one specimen, Cat. No. 17714, U.S.N.M., on *Cambarus dubius* Faxon, from Rock House River near Baileysville, West Virginia, August 17, 1900, U. S. B. F. (No. 873).

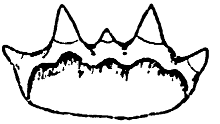

FIG. 5.—UPPER JAW OF XIRONODRILUS PULCHERRIMUS (MOORE), FROM QUEENS, WEST VIRGINIA. TYPE II.

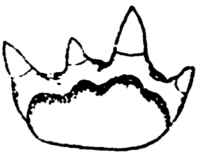

FIG. 6.—LOWER JAW OF XIRONODRILUS PULCHERRIMUS (MOORE). SAME SPECIMEN FIG. 5. TYPE III.

Through the kindness of Prof. J. P. Moore the writer received two specimens of this species collected by Professor Moore at Blowing Rock, North Carolina, in 1893. Both of these specimens have jaws of the 3–3 type, in accord with Moore's original description.[1] In the collections of the United States National Museum, however, 37 specimens were found which have jaws of the 4–4, 5–4, and 5–5 types, although these worms do not appear to differ in other characters from the North Carolina specimens or the original description of *Branchiobdella pulcherrima* Moore (=*X. pulcherrimus* (Moore)). Thirty of these 37 worms have the dental formula 5–4, and none of the 37 have the dental formula 3–3. In view of the fact that intergrading individuals with dental formula 4–3 may be found in subsequent collections (worms with dental formula 4–3 were found in collections of the closely related species, *X. formosus* Ellis) these 37 worms have been assigned to Moore's species *X. pulcherrimus*, and the dental formula of this species is considered as varying from 3–3 to 5–5. The jaws of the United States National Museum specimens were of types II and III, depending upon the number of teeth present. Moore's figure[1] may be interpreted as a jaw of type II without the teeth of the "*c*" order. It is possible that the North Carolina worms with the dental formula 3–3 and the West Virginia worms with dental formula 4–4, 5–4, and 5–5 may represent two distinct subspecies. As only two specimens from North Carolina were examined, a complete comparison on this point could not be made. The variations in the number of teeth in the worms studied are tabulated below.

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[1] Proc. Acad. Nat. Sci. Phila., vol. 45, 1895, p. 423.

TABLE 2.

Host and locality.	Dental formulae.				
	3–3	4–3	4–4	5–4	5–5
Cambarus bartonii (Fabricius), Blowing Rock, N. C.	2	....	....	....	....
Cambarus bartonii carinirostris Hay:					
Laurel Fork, Cheat River, West Virginia	....	....	2	6	....
Cheat Bridge, West Virginia	....	....	....	3	....
Shavers Fork, West Virginia	....	....	....	1	1
Cheat River near the Pike, West Virginia	....	....	....	1	....
Between Berverly and Elkins, West Virginia	....	....	1	7	....
Cambarus bartonii veteranus Faxon, Indian Creek, West Virginia	....	....	1	....	....
Cambarus obscurus Hagen:					
Queens, West Virginia	....	....	....	7	1
Trubies Run, West Virginia	....	....	1	4	....
Cambarus dubius Faxon, near Baileyville, West Virginia	....	....	....	1	....
Number of specimens, 39	2	....	5	30	2

XIRONOGITON, new genus.

Branchiobdellid worms having testes, nephridia, spermatheca, pharyngeal diverticula and intersegmental septa like those of the preceding genus, *Xironodrilus;* a distinct accessory sperm tube joining the atrium in segment VI; segment IX much reduced so that in dorsal view the body appears to be composed of eight or fewer segments; alimentary canal looped once or twice in segment VII, and in mature worms asymmetrically placed in segment VI, where the intestine is pushed to one side by the enlarged reproductive organs;

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[1] Proc. Acad. Nat. Sci. Phila., vol. 45, 1893, fig. 2c.

maximum enlargement of the alimentary canal in segment V; anal opening dorsal; caudal sucker ventral; body distinctly depressed; posterior segments wider and flatter than the anterior segments.

Type-species—*Xironogiton oregonensis*, new species.

Key to the three species and the two subspecies that have been placed in this genus.

a^1. A somewhat concave, glandular adhesive disk near each lateral margin of the ventral surface of segments VIII and IX; segments I to III constricted anteriorly and posteriorly so that the segmental junctions are well defined; dental formula 6–5. *X. occidentalis*, new species.

a^2. No conspicuous adhesive disks on the ventral surface of segments VIII and IX, although several small glands are usually present; body segments I to IV subequal and well defined, increasing slightly in width caudad; body segments V to VII abruptly expanded and flattened, much wider than the first four body segments; margins of segments V to IX so flattened that the segmental junctions are almost obliterated; general outline of the body and head flask-shaped.

- b^1. The two teeth of the longest pair in the upper jaw separated by two teeth; if two long teeth are contiguous the outer one is usually the longer. *X. oregonensis*, new species.
  - c^1. Dental formula 5–4, varying from 4–4 to 6–5. *X. o. oregonensis*, new subspecies.
  - c^2. Dental formula 6–6, varying from 6–5 to 7–6. *X. o. pectinatus*, new subspecies.
- b^2. The two teeth of the longest pair in the upper jaw separated by but one tooth; if two long teeth are contiguous the inner one is the longer. *X. instabilius* (Moore).

XIRONOGITON OCCIDENTALIS, new species.

Plate 12, fig. 2.

Type.—Cat. No. 17639, U.S.N.M., body length, 4.5 mm., Crab Creek, Washington (John T. Nichols), U. S. Bureau of Fisheries, on *Astacus klamathensis* Stimpson.

Paratype.—One specimen collected with the type.

Description.—Body somewhat elongate and distinctly depressed; body segments I to VIII distinct, each slightly constricted at its anterior and posterior ends giving the segmental junctions sharp definition; segment IX greatly reduced so that the body appears to be composed of but eight segments; segments expanding gradually and regularly in width to segment VII, which is the widest body segment; segment VIII almost as wide as segment VII; segments IX and X so narrow and inconspicuous that the caudal sucker appears to be inserted under the posterior half of segment VIII; head large, its anterior third defined by a groove; lips two, each with a slight median emargination, otherwise entire; a few short transparent bristles on the margins of the lips; major pharyngeal diverticula three, two dorsal and one ventral; the ventral diverticulum about midway between the levels of the two dorsal diverticula; dental formula 6–6, upper jaw type IV, lower jaw type IV, but with the two teeth of the "*a*" order unequal in size; tooth plan of upper jaw *C-B-a-a-B-C* teeth of the "*C*" order being slightly smaller than those of the "*B*" order but larger than those of the "*a*" order, the two "*a*" teeth unequal; differences in size of teeth slight so that the jaws approach the subequal-toothed jaw type; anterior nephridia alternating in segments II and III, opening to the outside through separate pores on the dorso-lateral surface of segment III; spermatheca simple; testes present in segments V and VI; vasa deferentia from segments V and VI joining the atrium in segment VI; a long accessory sperm tube present; alimentary canal not conspicuously expanded in the first three segments, wider in segment IV, increasing in diameter in segments V and VI, narrowing in segment VII, in which segment the intestine forms a more or less definite "*S*"-shaped curve; intestine narrowing rapidly in the anterior half of segment VIII and continuing as a somewhat crooked tube to the anal opening on the dorsal surface of the posterior half of segment IX; because of the reduced condition of segment IX, the anal opening is subterminal; adhesive glandular disks on segment VIII prominent, those on segment IX inconspicuous.

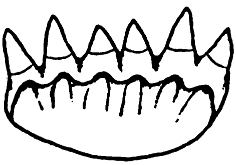

Fig. 7—Upper jaw of type-specimen of Xironogiton occidentalis Ellis, from Crab Creek Washington. Type IV.

The two specimens from which this species was described measured 4.5 and 5 mm., respectively. *X. occidentalis* resembles a large, much extended specimen of *X. instabilius* (Moore). It is easily separated from that species by the glandular disks on the ventral surface of segments VIII and IX and by the distinct segmental junctions.

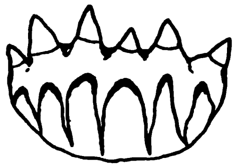

Fig. 8.—Lower jaw of type-specimen of Xironogiton occidentalis Ellis, from Crab Creek, Washington.

XIRONOGITON OREGONENSIS, new species.

Plate 10, figs. 1, 2; plate 12, fig. 1.

Type.—Cat. No. 17639, U.S.N.M., body length 1.3 mm., Eugene, Oregon (J. E. Guthberlet), October, 1914, on *Astacus klamathensis* Stimpson (det. Faxon).

Paratypes.—Four, Cat. No. 17640, U.S.N.M., and 10 others, collected with the type.

Description.—Body distinctly depressed, general outline of contracted specimens racket—or flask-shaped, extended specimens conspicuously wider in the posterior half of the body than in the anterior; head and body segments I and II subequal and subterete; segment IV distinctly wider than segment III and somewhat depressed; segments V to VIII conspicuously wider than the anterior portion of the body, rather completely fused at the segmental junctions so that the segmental junctions are not clearly defined as they are in the anterior four segments; maximum width of the body in segment VII; segments V and VIII subequal; segmental margins of segments V to VIII broadly flattened forming a conspicuous shelf beyond the thicker portion of the body; segment IX greatly reduced, not prominent in dorsal view; caudal sucker large, ventral, its width in contracted specimens about equal to that of the head; head large, in contracted specimens exceeding the first two body segments in size; head divided into two rather distinct units, the anterior being slightly shorter than the posterior; lips two, each with a median emargination; dental formula 5–4 or 6–5, varying from 4–4 to 7–6 (see subspecies); major pharyngeal diverticula three, two dorsal and one ventral; each anterior nephridium opening to the outside through a separate pore in segment III; spermatheca in segment V, small and simple, subglobose with a small dorsal tubular portion, not bifid; testes in segments V and VI; vasa deferentia from segments V and VI joining the large atrium in segment VI; accessory sperm tube present and well developed; alimentary canal rather straight in segments I to V, maximum enlargement in segment V, intestine more or less displaced (usually to the right) in segment VI depending upon the state of the enlargement of the reproductive organs in that segment; intestine forming two rather distinct loops in segment VII, decreasing rapidly in diameter from segment VII to the anal opening on the dorsal surface of segment IX; largest specimen examined was strongly contracted and measured 2.0 mm. in length.

The two lots of specimens of this species, from Eugene, Oregon, and Sequallitchew Lake, Washington, form a continuous series through the several types of dental formulae from 4–4 to 7–6, but none of the Washington worms have less than 6–5 teeth and the majority of the Oregon worms have 5–4 teeth, the maximum dentition of this series being 6–5. Correlated with this difference in dental formulae the Oregon specimens have upper jaws in which the two short median teeth of the "*a*" order are not equal in length, and the Washington worms have upper jaws with subequal "*a*" teeth. These two lots therefore have been regarded as representing two subspecies, *X. oregonensis oregonensis* and *X. oregonensis pectinatus*. The variation in teeth is shown below.

TABLE 3.

Locality.	Dental formulae.					
	4–4	5–4	5–5	6–5	6–6	7–6
Eugene, Oregon	1	8	3	2	....	....
Sequallitchew Lake, Washington	....	....	....	4	1	3

The jaws of *X. oregonensis* seem to have a 6-tooth plan, the upper jaw having the six teeth symmetrically arranged in the order *c-B-a-a-B-c.*, that is a short, a long, two shorts, a long and a short. The majority of the specimens of *X. oregonensis oregonensis* have jaws of the formula 5–4, the teeth of the upper jaw being *c-B-a-a-B*. The short outside tooth "*c*" suggests the absence of a similar tooth on the opposite side of the jaw to complete the 6-toothed plan. In the 6–6 type of *X. oregonensis pectinatus* the teeth of the upper jaw are symmetrically placed with reference to the median axis of the jaw, being *c-B-a-a-B-c*. In the jaws of this subspecies, however, the two teeth of order "*a*" are subequal and the "*B*" teeth, although longer than the teeth of the "*c*" and "*a*" orders, are relatively shorter than the "*B*" teeth in the jaws of *X. oregonensis oregonensis.* For the specimens of *X. oregonensis pectinatus* having the dental formula 7–6 the teeth of the upper jaw may be represented by the letters *c-B-a-a-B-c-d.* In the jaws of the three worms having 7–6 teeth, the extra tooth of the upper jaw "*d*" was far enough out of line to show a distinct lack of symmetry with reference to the other teeth of the jaw.

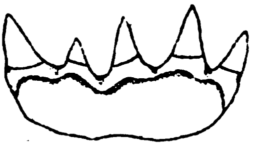
FIG. 9.—UPPER JAW OF TYPE-SPECIMEN OF XIRONOGITON OREGONENSIS OREGONENSIS ELLIS, FROM EUGENE, OREGON.

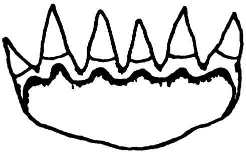
FIG. 10.—UPPER JAW OF TYPE-SPECIMEN OF XIRONOGITON OREGONENSIS PECTINATUS ELLIS, FROM SEQUALLITCHEW LAKE, WASHINGTON.

XIRONOGITON OREGONENSIS OREGONENSIS Ellis.

Dental formula 5–4, varying from 4–4 to 6–5; the two small, median teeth of the order "*a*" separating the two tall teeth of the order "*B*" of the upper jaw not subequal.

XIRONOGITON OREGONENSIS PECTINATUS, new subspecies.

Plate 12, fig. 3.

Type.—Cat. No. 17641, U.S.N.M., body length 1.3 mm., Sequallitchew Lake near the creek, Pierce County, Washington, 4 miles south of Steilacoom, April 26, 1904, host not given.

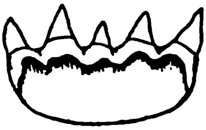
FIG. 11.—LOWER JAW OF TYPE-SPECIMEN OF XIRONOGITON OREGONENSIS PECTINATUS ELLIS, FROM SEQUALLITCHEW LAKE, WASHINGTON.

Paratypes.—Six Cat. No. 17642, U.S.N.M., and two others, collected with the type.

Dental formula 6–5, varying from 6–5 to 7–6; the two small, median teeth of the order "*a*" separating the two tall teeth of the order "*B*" of the upper jaw, subequal; all of the teeth of the upper jaw prominent, the differences in length of teeth small, the teeth of the order "*B*" not conspicuously longer than the other teeth of the jaw.

XIRONOGITON INSTABILIUS (Moore).

Plate 13, figs. 1 and 3.

Branchiobdella instabilia MOORE, Proc. Acad. Nat. Sci. Phila., vol. 45, pp. 425–427, pl. 12, figs. *3a*, *3b*, *3c*, and *3e*, 1893 (Wautauga County, North Carolina, and Delaware County, Pennsylvania).—SMALLWOOD, Biol. Bull., vol. 11, No. 2, pp. 100–110, fig. 1, 1906 (Lake Clear, Harrietstown, Franklin County, New York).

Specimens.—Twelve (8=Cat. No. 17643, U.S.N.M.), Stoney Man Mountain, Virginia (Palmer and King), on *Cambarus bartonii* (Fabricius); seven (6=Cat. No. 17644, U.S.N.M.), West branch of Glennark Creek, North Rose, New York (A. C. Weed), on *Cambarus bartonii robustus* (Hay); six (5=Cat. No. 17645, U.S.N.M.), Trubies Run, a tributary of the Buckhannon River, 7 miles above Buckhannon, West Virginia, August 4, 1899 (U.S.F.C.), on *Cambarus obscurus* Hagen; six, Blowing Rock, Wautauga County, North Carolina, 1893 (J. P. Moore), on *Cambarus bartonii* (Fabricius); three (2=Cat. No. 17646, U.S.N.M.), Chenowith Creek between Beverly and Elkins, West Virginia, July 4, 1899 (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; two (Cat. No. 17647, U.S.N.M.), Cheat Bridge, Randolph County, July 24, 1899 (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; two (Cat. No. 17648, U.S.N.M.), Right Hand Fork of Chenowith Creek, a tributary of the Cheat River, Queens, West Virginia (U.S.F.C.), on *Cambarus obscurus* Hagen; two (Cat. No. 17649, U.S.N.M.), Elk River at Cogars Mill, West Virginia (U.S.F.C.), on *Cambarus bartonii* subspecies; one (Cat. No. 17650, U.S.N.M.), Cheat River, near the Pike, West Virginia, July 25, 1899 (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay.

The dental formula of this species varies from 4–4 to 5–5 as shown by the table below, compiled from the specimens examined. The teeth of this species as described by Moore are 4–4, the original description stating that, "the dark brown jaws are provided with four strong, curved, conical teeth, which diverge slightly; the outer pair are symmetrical, the left tooth of the middle pair is much larger than the right; this being the case in both jaws in nearly all of the many specimens examined."[1] Through the kindness of Professor Moore the writer received seven specimens of this species collected by him at Blowing Rock, North Carolina, in 1893. The jaws of three of these worms have 4–4 teeth as described by Moore; two other specimens have jaws of the 5–4 type and are similar to many specimens found in the United States National Museum collections; and the teeth of the other two could not be counted.

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[1] Proc. Acad. Nat. Sci. Phila., vol. 45, 1893, pp. 425–426.

TABLE 4.

Host and locality.		Dental formulae.		
		4-4	5-4	5-5
Cambarus bartonii (Fabricius):				
Stoney Man Mountain, Virginia		7	2	1
Blowing Rock, North Carolina		3	2	....
Cambarus bartonii carinirostris Hay:				
Cheat River, West Virginia		1	....	1
Cheat River near the Pike, West Virginia		....	....	1
Chenowith Creek, West Virginia		1	1	....
Cambarus bartonii robustus (Hay), Glennark Creek, North Rose, New York		2	2	3
Cambarus bartonni subspecies, Cogars Mill, West Virginia		....	2	....
Totals from *Cambarus bartonii*	29	14	9	6
Cambarus obscurus Hagen:				
Trubies Run, West Virginia		1	1	4
Queens, West Virginia		1	1	....
Totals from *Cambarus obscurus*	8	2	2	4
Grand totals	37	16	11	10

As pointed out in the key to this genus the arrangement of the teeth on the jaws of this species is different from the western species, *X. oregonensis* Ellis. In *X. instabilius* (Moore) the upper jaw, when symmetrical, has five teeth, *c-B-a-B-c;* that is, a short, a long, a short, a long, and a short. If the upper jaw bears but four teeth, as described by Moore and as found in over one-third of the specimens examined, the tooth plan is *c-B-a-B* or *B-a-B-c*. This arrangement may be explained by the loss of one of the "*c*" teeth. In some of the 4-4 type the upper jaw seemed at first to be composed of a long, a short, and two longs; that is, two long teeth were contiguous on one side of the jaw. By careful measurements it could be shown in every case that the outer of the two contiguous long teeth was shorter than the inner. This type of asymmetrical 4-toothed jaw therefore has been considered a modified type of the 5-toothed jaw. The elongation of the odd outside tooth of the "*c*" order; that is, the shorter of the two long contiguous teeth, in this type of 4-toothed jaw probably represents a compensatory regulation, as the teeth of a 4-toothed jaw do not have the same alignment with the teeth of the lower jaw as do the teeth of a 5-toothed jaw.

Genus PTERODRILUS Moore, 1894.

Pterodrilus MOORE, Proc. Acad. Nat. Sci. Phila., p. 449, 1894.

One of the two species described by Moore at the time this genus was designated was found in the collections examined, and two new species have been added. With these additions this genus includes four species which may be distinguished by the following key:

a.[1] Dorsal portions of one or more body segments bearing branched or digitate processes.

b.[1] Dorsal processes present on more than one segment.
  c.[1] Processes on segments II to VIII, inclusive. *P. distichus* Moore.
  c.[2] Processes on segments III, IV, V, and VIII (Moore,[1] not seen). *P. alcicornus* Moore.
b.[2] Processes on segment VIII only. *P. mexicanus*, new species.
a.[2] Dorsal portions of several segments elevated; segments VII and VIII, with funnel-shaped enlargements of the dorsal portions; funnel of segment VIII excavated dorsally so that its dorsal margin bears two small "horns." *P. durbini*, new species.

PTERODRILUS DISTICHUS Moore.

Pterodrilus distichus Moore, Proc. Acad. Nat. Sci. Phila., pp. 453–454, pl. 13, figs. 2, 2*a*–2*d*, 1894 (western New York on *Cambarus bartonii* (Fabricius)).

Specimens.—25 (2=Cat. No. 17651, U.S.N.M.), Oxford, Ohio (S. R. Williams), host not given; 20 (10=Cat. No. 17652, U.S.N.M.), Cedar Point, Ohio (S. R. Williams), host not given; 50 (15=Cat. No. 17653, U.S.N.M.), White River, Irondale, near Anderson, Indiana, August, 1915 and 1916 (M. M. Ellis), on *Cambarus rusticus* Girard (det. Faxon); three, White River, Noblesville, June 23, 1915 (M. M. Ellis), on *Cambarus rusticus* Girard.

PTERODRILUS MEXICANUS, new species.

Type.—Cat. No. 17654, U.S.N.M., body length 1.0 mm., Mirador, State of Vera Cruz, Mexico (Nelson and Goldman), on *Cambarus mexicanus* Erichson.

The type-specimen was unique, and, unfortunately, poorly preserved. Consequently but a brief diagnosis can be given. General body form similar to *Pterodrilus distichus* Moore; no dorsal processes on segments II to VII, inclusive; segment VIII bearing a simple four-horned appendage like that on the same segment of *P. distichus;* dental formula 5–4; upper jaw type IX, lower jaw type X. As far as the internal anatomy could be traced in a whole mount this poorly preserved specimen the organs resembled those of *P. distichus* Moor and *P. durbini*, new species.

PTERODRILUS DURBINI, new species.

Plate 11, fig. 1.

Type.—Cat. No. 17655, U.S.N.M., body length 1.5 mm., White River, Irondale, near Anderson, Indiana, August, 1916 (M.M. Ellis), on *Cambarus rusticus* Girard (det. Faxon).

Paratypes.—Two, Cat. No. 17655, U.S.N.M., and 10 others collected with the type.

Description.—Body rather short and thick, size small; width of the head scarcely equaling the width of segment I; body segments increasing rapidly in diameter from segment I to segment VII; seg-

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[1] Proc. Acad. Nat. Sci. Phila., 1893, p. 450.

ment VII (sometimes segment VI) the wide segment of the body; at least 10 body segments visible in side view; major and minor annulations of segment I of about the same diameter, the major annulation, however, being about twice the length of the minor annulation; major annulations of segments II, III, and IV conspicuously elevated laterally and dorsally, forming rufflelike bands around the anterior halves of each of these three segments; minor annulation of segment V almost obliterated, major annulation of segment V elevated dorsally and laterally into a midsegmental crest which almost encircles the segment; major annulation of segment VI low, the minor annulation elevated into an encircling segmental crest; major annulation in segment VII elevated and expanded into a funnel-shaped collar which encircles the segment and stands free from it except at the junction of the segment proper and the collar, the bell of the funnel being directed cephalad; minor annulation of segment VII low; major annulation of segment VIII elevated and expanded into a funnel-shaped collar like that on segment VII, except that the funnel of segment VIII is directed posteriorly, its bell opening caudad and standing free above the low minor annulation of segment VIII; dorsal margin of the funnel-shaped collar of segment VIII excavated in the mid-dorsal line, so that the margin of the funnel shows two distinct "horns" when seen from front or rear; segments IX and X low, small, and regular; head not exceeding the first two body segments in length, divided into three rather equal thirds by two indistinct grooves; lips two, the upper the longer, both slightly emarginate in the median line; oral bristles present; dental formula 5–4; upper jaw type IX, lower jaw type X; major pharyngeal diverticula two, one dorsal and one ventral; alimentary canal straight, maximum enlargement in segment IV; testes in segments V and VI; vasa deferentia from segments V and VI meeting in segment VI; no accessory sperm tube; spermatheca simple and tubular; caudal sucker large, termino-ventral; its diameter equalling or exceeding the greatest diameter of the head; largest specimen examined 2.0 mm. in length.

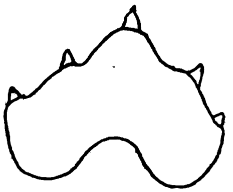

FIG. 12.—UPPER JAW, ANTERIOR FACE VIEW, OF TYPE-SPECIMEN OF PTERODRILUS DURBINI ELLIS, FROM ANDERSON, INDIANA. TYPE IX.

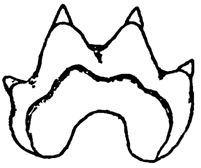

FIG. 13.—LOWER JAW OF TYPE-SPECIMEN OF PTERODRILUS DURBINI ELLIS, FROM ANDERSON, INDIANA. TYPE X.

For Mr. D. H. Durbin, whose interest in this work made possible a large number of collections in the White River drainage.

Genus CAMBARINCOLA Ellis, 1912.

Cambarincola ELLIS, Proc. U. S. Nat. Mus., vol. 42, p. 481, 1912.

Five species have been referred to this genus. Two of these species, *C. philadelphica* (Leidy) and *C. chirocephala*, new species, have several characters in common with members of the genus *Stephanodrilus* as defined by Pierantoni in his Monografia dei Discodrilidae, 1912.[1] One of these characters, "the plurilobate prostomium" is particularly noteworthy in this connection as it is used by Pierantoni to differentiate *Stephanodrilus* in his generic key. The two species *C. philadelphica* and *C. chirocephala* have lobate lips similar to the lips of *Stephanodrilus japonicus* Pierantoni as figured by Pierantoni.[1] Neither *Stephanodrilus koreanus* Pierantoni nor *Stephanodrilus japonicus* Pierantoni, however, are figured with accessory sperm tubes, and the accessory sperm tube is present in species of *Cambarincola.* Pierantoni also figures *Branchiobdella digitata* Pierantoni, a species having but a single pair of testes, (Pierantoni), with a plurilobate prostomium, showing that the lobate lip character occurs in that group of species. No data concerning the pharyngeal diverticula of Pierantoni's species were obtainable.

a^1. Upper and lower lips entire excepting a small, median emargination; not divided into lobes which may be extended as tentacles; two small lobes present in the median emargination of the upper lip in species with dental formula 3–4.

b^1. Dental formula 5–4.

c^1. Middle tooth of the upper jaw long and prominent, the lateral teeth of the "*c*" and "*b*" orders, small. *C. macrodonta* Ellis.

c^2. Middle tooth of the upper jaw longer than the other four teeth, but small enough so that all five teeth may be considered as almost subequal; lateral teeth of the "*c*" and "*b*" orders from one-half to three-fourths as long as the middle "*A*" tooth. *C. vitrea*, new species.

b^2. Dental formula 3–4; middle tooth of the upper jaw long and prominent, lateral teeth small; teeth of the "*c*" order wanting. *C. inversa*, new species.

a^2. Upper lip composed of four subequal lobes, which may be extended as digitiform tentacles; lower lip composed of two subequal lobes which may be extended also; a small lateral lobe on each side at the junction of the upper and lower lips.

d^1. Dental formula 5–4, middle tooth of the upper jaw long and prominent; lateral teeth of the "*c*" and "*b*" orders small, one-half the length of the middle tooth or less; jaws subequal, the upper slightly larger than the lower. *C. philadelphica* (Leidy).

d^2. Dental formula apparently 1–4, but actually 5–4; middle tooth of the upper jaw long and prominent, lateral teeth of the "*c*" and "*b*" orders very small, not exceeding one-sixth the length of the middle "*A*" tooth; upper jaw much larger than the lower, from one and three-quarters to three times as wide as the lower jaw. *C. chirocephala*, new species.

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[1] Annuario del Museo Zool. della R. Univ. Napoli, n. s., vol. 3, num. 24, Feb. 29, 1912, pp. 1–28, pl. 5.

CAMBARINCOLA MACRODONTA Ellis.

Cambarincola macrodonta ELLIS, Proc. U. S. Nat. Mus., vol. 42, pp. 481-486, figs. 1-5, 1912 (Boulder, Colorado, on *Cambarus diogenes* Girard).

Specimens.—Nine (7-Cat. No. 17656, U.S.N.M.), Fort Clark, Texas (E. A. Mearns), on *Cambarus clarkii;* one (Cat. No. 17657, U.S.N.M.), New Orleans, Louisiana (R. W. Shufeldt), on *Cambarus diogenes ludovicianus* Faxon; two (1-Cat. No. 17658, U.S.N.M.) Sims Bayou, Houston, Texas (B. W. Evermann), on *Cambarus blandingii acutus* Faxon (host determination uncertain); one (Cat. No. 17659, U.S.N.M.), Lake Lapoudre, Morgan City, Louisiana, on *Cambarus clarkii;* five (3-Cat. No. 17660, U.S.N.M.), Frierson, Louisiana, on *Cambarus blandingii acutus* Faxon; two (one-Cat. No. 17661, U.S.N.M.), Las Vegas, New Mexico (T. D. A. Cockerell), on *Cambarus gallinas* Cockerell and Porter; 15 (10-Cat. No. 17663, U.S.N.M.), Muldon, Mississippi (W. H. Baker), on *Cambarus hagenianus* Faxon; 25 (10-Cat. No. 17665, U.S.N.M.), Agricultural College, Mississippi (Earl Wilson); three (Cat. No. 17662, U.S.N.M.), Fort Collins, Colorado (L. C. Bragg), on *Cambarus diogenes* Girard; 25 (10-Cat. No. 17664, U.S.N.M.), Black Wolf Creek, near Beecher's Island, Colorado (B. Jaffa), October, 1915, on *Cambarus diogenes* Girard; 10 (5-Cat. No. 17666, U.S.N.M.), Arikaree River, near Beecher's Island, Colorado (G. C. Roe), October, 1915, on *Cambarus diogenes* Girard; 25 (10-Cat. No. 17667, U.S.N.M.), Boulder, Colorado (M. M. Ellis), September, 1916, on *Cambarus diogenes* Girard.

CAMBARINCOLA VITREA, new species.

Plate 10, fig. 3.

Type.—Cat. No. 17668 U.S.N.M., body length 3.0 mm., Douglas Lake, Michigan, July, 1915 (M. M. Ellis), on *Cambarus virilis* Hagen (det. Faxon).

Paratypes.—Three, Cat. No. 17668 U.S.N.M., and 15 others, collected with the type.

Additional specimens.—Twenty-five (5-Cat. No. 17669, U.S.N.M.), Rhinelander, Wisconsin, October, 1915, (G. Hansen) on *Cambarus virilis* Hagen (det. Faxon); 25 (5-Cat. No. 17670, U.S.N.M.), St. Vrains, Colorado, May, 1915 (M. M. Ellis), on *Cambarus immunis* Hagen; 10 (2-Cat. No. 17671, U.S.N.M.), Rolla, Missouri, October, 1915 (J. Barley), on *Cambarus virilis* Hagen (det. Faxon); 50 (5-Cat. No. 17672, U.S.N.M.), Maple River, Douglas Lake, Michigan, summers of 1915 and 1916, on *Cambarus propinquus* Girard (det. Faxon); 25 (2-Cat. No. 17673, U.S.N.M.), Lake Huron, Cheboygan, Michigan, August, 1915 (M. M. Ellis), on *Cambarus propinquus* Girard and *Cambarus virilis* Hagen; 50, (3-Cat. No. 17674, U.S.N.M.), Grapevine Point, Douglas Lake, Michigan, summers of 1914, 1915, and 1916 (M. M. Ellis), on *Cambarus propinquus* Girard; 10 (2-Cat. No. 17675, U.S.N.M.), Wellington, Illinois, September, 1914 (A. T. Evans), on *Cambarus virilis* Hagen (det. Faxon); 15 (3-Cat. No. 17676, U.S.N.M.), Urbana, Illinois (Frank Smith), on *Cambarus virilis* Hagen; 20 (2-Cat. No. 17677, U.S.N.M.), Arikaree River, near Beecher's Island, Colorado, October, 1915 (B. Jaffa), on *Cambarus virilis* Hagen; three (2-Cat. No. 17678, U.S.N.M.), St. Marys River, Fort Wayne, Indiana (host not given); two (1-Cat. No. 17679, U.S.N.M.), mouth of Carp River, St. Martins Bay, near Straits of Mackinac (J. T. Scovell), on *Cambarus virilis* Hagen.

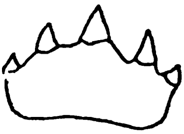

FIG. 14.—UPPER JAW OF TYPE-SPECIMEN OF CAMBARINCOLA VITREA ELLIS, FROM DOUGLAS LAKE, MICHIGAN, ANTERIOR FACE VIEW.

Description.—Body and head subterete, little if at all depressed; diameter of the head approximately equal to that of segment II, usually slightly greater than that of segment I; body segments II to VIII subequal, segments V. VI, and VII when distended with sex cells slightly wider than segments III and IV; segments posterior to VIII narrowing rather rapidly to the caudal sucker, the diameter of which is less than of the head; all body segments easily visible in side view; major annulations distinct, but very slightly elevated above the minor annulations; head divided into three subequal parts, the anterior being the most distinct of the three; lips two, subequal, each with a small, median emargination; major pharyngeal diverticula two, the dorsal slightly anterior to the ventral; a few short bristles present on each lip; dental formula 5-4, upper jaw between types V and VII, lower jaw of general plan of type VIII but with all four teeth almost subequal; alimentary canal straight, following the mesial line of the body, maximum enlargement in segment IV; anterior nephridia opening to the outside through a common pulsatile pore on the dorsal surface of the major annulation of segment III; spermatheca simple and tubular; testes present in segments V and VI vasa deferentia from segments V and VI, meeting the atrium in segment VI; accessory sperm tube present; largest specimen examined, 4.7 mm.

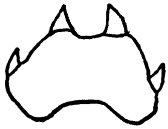

FIG. 15.—LOWER JAW OF TYPE-SPECIMEN OF CAMBARINCOLA VITREA ELLIS, FROM DOUGLAS LAKE, MICHIGAN, ANTERIOR FACE VIEW.

This species superficially resembles *Xironodrilus formosus* Ellis, both in body form and type of jaws. In addition to the several generic characters by which these two species may be separated, it may be noted that the jaws, although having the same number of teeth and the same general form, are quite different. (See figures.)

CAMBARINCOLA INVERSA, new species.

Plate 11, fig. 3.

Type.—Cat. No. 17680, U.S.N.M., body length 2 mm., Eugene, Oregon (J. E. Gutberlet), on *Astacus klamathensis* Stimpson (det. Faxon).

Paratypes.—Five, Cat. No. 17680, U.S.N.M., and 15 others collected with the type.

Description.—Body rather elongate and more or less terete; width of the head approximately equal to that of segment I; body segments increasing in width regularly and gradually from segment I to segment VI, which is the widest segment of the body; segments VII and VIII slightly narrower than segment VI; body posterior to segment VIII narrowing rapidly to the caudal sucker; all 11 body segments visible in side view and 9 or more visible in dorsal view; caudal sucker termino-ventral, its diameter less than that of the head; each segment, slightly constricted anteriorly and posteriorly, so that the segmental junctions are distinct; head subcylindrical, its anterior third defined by a groove or constriction; length of the head in moderately expanded specimens slightly less than the length of the first two body segments; lips, two, the upper slightly longer than the lower; the lower lip with a distinct median emargination; upper lip like the lower, but with two small lobes in the base of the emargination; oral bristles present; dental formula 3–4, varying 3–3 to 5–4 (see table); upper jaw with three large teeth, of which the middle one is the longest, all three directed forward—that is, away from the base of the jaw; dental ridge of the upper jaw usually with a small tubercle in the position of the teeth of the "*c*" order—that is, if the jaw were five-toothed (teeth were found on these tubercles in two specimens, the tooth point in each case being very small); lower jaw with two large teeth and two small lateral teeth; upper jaw 20 micra wide, lower jaw 17 micra wide in an expanded worm measuring 3.6 mm.; major pharyngeal diverticula two, one dorsal and one ventral; anterior nephridia alternating in segments II and III, opening to the outside in segment III through a common pore in the dorsal surface of the major annulation of segment III; spermatheca simple, long, and tubular, not bifid; testes present in segments V and VI, vasa deferentia from segments V and VI meeting in the atrium in segment VI; alimentary canal straight, increasing in diameter in segment I, much expanded in segments II, III, and IV, in which segments it forms an almost continuous pouch; intestine narrowing

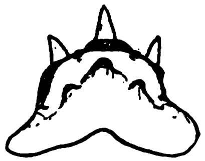
FIG. 16.—UPPER JAW OF CAMBARINCOLA INVERSA ELLIS, FROM EUGENE, OREGON.

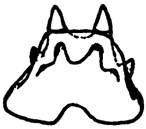
FIG. 17.—LOWER JAW OF CAMBARINCOLA INVERSA ELLIS, FROM EUGENE, OREGON.

in the posterior half of segment IV; alimentary canal following the mesial line of the body through segments V to IX, swinging dorsad through segment IX to anal opening on the dorsal surface of segment X.

The variation in the number of teeth of 20 specimens of this species is shown in the following table:

TABLE 5.

Locality.	Dental formulae.		
	3-3	3-4	5-4
Eugene, Oregon	1	17	2

CAMBARINCOLA PHILADELPHICA (Leidy).

Astacobdella philadelphica LEIDY, Proc. Acad. Nat. Sci. Phila., p. 209, 1851, on *Astacus bartonii* Fabricius.

Branchiobdella philadelphica (Leidy) MOORE, Proc. Acad. Nat. Sci. Phila., pp. 427–428, pl. 12, figs. 4*a*–4*c*, 1893.

Specimens.—Five (three=Cat. No. 17861, U.S.N.M.), Cheat Bridge, West Virginia (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; four (1=Cat. No. 17682, U.S.N.M.), Chenowith Creek, between Beverly and Elkins, West Virginia (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; two (Cat. No. 17683, U.S.N.M.), Laurel Fork of Cheat River, near Seneca Point, West Virginia, on *Cambarus bartonii carinirostris* Hay; four (Cat. No. 17684, U.S.N.M.), Right Hand Fork at Queens, West Virginia (U.S.F.C.), on *Cambarus obscurus* Hagen; five (Cat. No. 17685, U.S.N.M.), Rock House River, near Baileyville, West Virginia, on *Cambarus dubius* Faxon; one (Cat. No. 17686, U.S.N.M.), Bargers Springs, Hilton, West Virginia, on *Cambarus bartonii* (Fabricius); one (Cat. No. 17687, U.S.N.M.), Crane Creek, West Virginia, on *Cambarus bartonii veteranus* Faxon; five (3=Cat. No. 17688, U.S.N.M.), Elk River at Cogar's Mill, West Virginia (U.S.F.C.), on *Cambarus bartonii* subspecies; two (Cat. No. 17689, U.S.N.M.), Cheat River near the Pike, West Virginia (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; two (one=Cat. No. 17690, U.S.N.M.), Tilhance Creek, Black Creek Valley, West Virginia (E. L. G.); one (Cat. No. 17691, U.S.N.M), Indian Creek, tributary of the Elk River in Kanawha County, West Virginia on *Cambarus bartonii veteranus* Faxon; three (one=Cat. No. 17692, U.S.N.M.), Stone Coal Creek, between Buckhannon and Weston, West Virginia (U.S.F.C.), on *Cambarus obscurus* Hagen; one (Cat. No. 17693, U.S.N.M.), War Creek, headwaters of the Big Sandy in McDowell County, West Virginia, on *Cambarus dubius* Faxon; five (3=Cat. No. 17694, U.S.N.M.), Coney

Creek, Bainbridge, Pennsylvania (B. A. Bean), on *Cambarus bartonii* (Fabricius); 14 (7=Cat. No. 17695, U.S.N.M.), Stoney Man Mountain, Virginia (Palmer and King), on *Cambarus bartonii* (Fabricius); ten (7=Cat. No. 17696, U.S.N.M.), North Fork of Blackwater, Courtland, West Virginia (U.S.F.C.), on *Cambarus bartonii carinirostris* Hay; ten (2=Cat. No. 17697, U.S.N.M.), Raleigh, North Carolina (C. S. Brimley), May, 1915, on *Cambarus bartonii acuminatus* Faxon and *Cambarus latimanus* LeConte (det. Faxon); one (Cat. No. 17698, U.S.N.M.), Wytheville, Virginia (M. McDonald), on *Cambarus bartonii* (Fabricius); one (Cat. No. 17699, U.S.N.M.), Cabin John, Maryland (McAtee and Wood), on *Cambarus bartonii* (Fabricius); one (Cat. No. 17700, U.S.N.M.) Scholarie Creek, Green County, Catskills, New York (E. A. Mearns), on *Cambarus bartonii* (Fabricius); two (one=Cat. No. 17701, U.S.N.M.), Spring Branch, 3 miles east of Mammoth Cave, Kentucky (W. P. Hay), on *Cambarus bartonii tenebrosus* Hay; two (Cat. No. 17702, U. S. N. M.), Left Hand fork of Middle Fork of Valley, Cassiday, West Virginia (U.S.F.C.), on *Cambarus obscurus* Hagen; two (one=Cat. No. 17705, U.S.N.M.), East River, West Virginia, on *Cambarus bartonii* (Fabricius); four (Cat. No. 17703, U.S.N.M.), Trubies Run, West Virginia (U.S.F.C.), on *Cambarus obscurus* Hagen; two (one=Cat. No. 17704, U.S.N.M.), between Paoli and Wyandotte, Indiana (O. P. Hay), on *Cambarus rusticus* Girard; two (Cat. No. 17706, U.S.N.M.), St. Marys River, Fort Wayne, Indiana; five (2=Cat. No. 17707, U.S.N.M.), Bluffton, Indiana (E. B. Williamson), on *Cambarus rusticus* Girard; 10, Rhinelander, Wisconsin (G. Hansen), on *Cambarus diogenes* Girard (det. Faxon); 50 (4=Cat. No. 17708, U.S.N.M.), Maple River, Douglas Lake, Michigan, summers of 1914, 1915, and 1916 (M. M. Ellis) on *Cambarus propinquus* Girard and *Cambarus virilis* Hagen (det. Faxon); 25 (4=Cat. No. 17709, U.S.N.M.), Bloomington, Indiana (Will Scott), May, 1915, on *Cambarus propinquus* Girard (det. Faxon); 200 (10=Cat. No. 17710, U.S.N.M.), White River, Irondale, Anderson, Indiana, summers of 1914, 1915, and 1916 (M. M. Ellis) on *Cambarus rusticus* Girard (det. Faxon); 10 (4=Cat. No. 17711, U.S.N.M.), Oxford, Ohio (S. R. Williams); 10 (2=Cat. No. 17712, U.S.N.M), North Judson, Indiana (P. S. Welch).

In the original description of this species Leidy[1] gives the following: "Head campanulate, terminated by a circular or elliptical crenated lip, fringed with very minute stiff hairs; dental plates brown, nearly equal, forming an isoceles triangle, with the base longest and attached, apex of superior plate ending in a sharp conical point with several minute denticulations on each side; apex of inferior plate bifurcated into two points, with two minute denticulations on each side." From this description the lower jaw may be regarded as a six-toothed jaw, having two large apical teeth and two small teeth on each side. The upper jaw is not so easily understood. The upper jaw bears "x" teeth, if x=1 plus y, in which statement "y" is more than two (*several minute denticulations*, according to Leidy). This interpretation of the upper jaw would give it a minimum of seven teeth; that is, one large tooth plus at least three teeth on each side.

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[1] Proc. Acad. Nat. Sci. Phila., 1851, p. 209.

Moore[1] figures a specimen which he assigns to Leidy's species, having jaws of the dental formula 7–10. The upper jaw as figured has one large apical tooth, and three small denticles on each side, and the lower jaw has two large teeth, and four small denticles on each side. Moore's figure of the head of this worm shows the upper lip to be composed of four distinct but small lobes, and the lower lip of two large subequal lobes. At the junction of the upper and lower lips on each side is a small intermediate lobe. These six lobes are small enough to fall in Leidy's description of a "circular or elliptical, crenated lip."

From the examination of a large series of specimens and a study of many living individuals at Douglas Lake, Michigan, the usual dental formula of this species seems to be 5–4. The upper jaw has one large tooth with two small denticles on each side and the lower two large teeth with two small denticles. The variation in the number of teeth figured and described may be accounted for by the fact that the sides of both upper and lower jaws of this species often bear small tubercles below the small denticles—that is, toward the base of the jaw—and these small tubercles could easily be confused with teeth. As understood in this paper, a tooth or denticle is a tubercle on the dental face bearing a distinct tooth cap. These tooth caps are lighter in color than the dental ridge, have 5 definite points and definite form. Two specimens from Tilhance Creek, West Virginia, one from Indian Creek, West Virginia, and one from Douglas Lake, Michigan, had jaws with more teeth—that is, definite teeth with tooth caps—than the regular 5–4 type, showing that some variation does occur.

The plurilobate condition of the prostomium is regular and definite, the upper lip having four subequal lobes, the lower, two large, subequal lobes with a small, often inconspicuous, lobe present at the junction of the upper and lower lip on each side of the mouth. In the living worms it was observed that the four lobes of the upper lip and, to a less extent, the two lobes of the lower lip could be extended to form distinct tentacles on the lips. Several specimens from various localities were found in the collections, killed with these tentacles fully extended. Most of the preserved specimens examined showed these tentacles, the lobes of the lips being extended beyond the level of the lips so that the tentacles, although small, were distinct. It was also found that worms of this species could flatten the entire lip, so that the lobes were scarcely visible. Preserved specimens which had been killed with the lips in this flattened condition were separated often with difficulty from individuals of the first group of species of this genus, but close examination in nearly every case showed the regular emarginations marking the location of lobes of lips. The lobes were easily seen in a young worm less than three hours old which was examined in water. This worm extended and contracted the lobes in the same manner as an adult. *Cambarincola philadelphica* was the most variable species studied.

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[1] Proc. Acad. Nat. Sci. Phila. 1898, pl. 12.

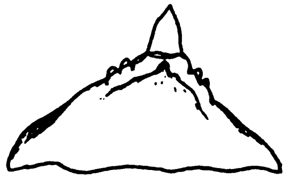


FIG. 18.—UPPER JAW OF TYPE-SPECIMEN OF CAMBARINCOLA CHIROCEPHALA ELLIS, FROM ROLLA, MISSOURI. TYPE VII.

CAMBARINCOLA CHIROCEPHALA, new species.

Type.—Cat. No. 17713, U.S.N.M., body length 2 mm., Rolla, Missouri (J. Barley), on *Cambarus virilis* Hagen (det. Faxon).

Paratypes.—One, Cat. No. 17713, U.S.N.M., and three others, collected with the type.

Description.—General body form that of *Cambarincola philadelphica* (Leidy); body segments evident, major annulations of segments especially in contracted specimens, distinctly and visibly elevated above the minor annulations; body segments increasing regularly and gradually in diameter from segment I to segment VI or VII, and decreasing slightly from segment VIII to the caudal sucker; body terete; head large, equalling the first two body segments in length and exceeding the first segment in width; lips two, upper composed of four subequal lobes which may be extended into four distinct digitiform tentacles, or may be so flattened as to give the lip an almost entire outline; lower lips of two larger, subequal lobes which are usually somewhat extended; a very small intermediate lobe at the junction of the upper and lower lip on each side of the mouth; major pharyngeal diverticula two, a dorsal and a ventral, the dorsal diverticulum being slightly cephalad of the ventral; dental formula 5-4; upper jaw very large, its width two or three times that of the lower jaw, teeth of the "*c*" and "*b*" orders on each side very small, less than one-sixth the height of tooth "*A*," the jaw

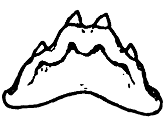


FIG. 19.—LOWER JAW OF TYPE-SPECIMEN OF CAMBARINCOLA CHIROCEPHALA ELLIS, FROM ROLLA, MISSOURI. TYPE VIII.

appearing to have but one large tooth when examined under low magnification; lower jaw of type VIII, teeth of the usual proportions for that type; anterior nephridia opening to the outside through a common pore in segment III; spermatheca simple, bulbous; testes in segments V and VI, vasa deferentia from segments V and VI meeting in segment VI.

TABLE 6.—*Distribution of Branchiobdellids examined according to host.*

Host species of crayfish.	Xironodrilus.		Xironogiton.				Pterodrilus.			Cambarincola.					
	formosus.	pulcherrimus.	occidentalis.	o. oregonensis.	o. pectinatus.	instabilius.	distichus.	mexicanus.	durbini.	macrodonta.	vitrea.	inversa.	philadelphica.	chirocephala.	Total.
A. klamathensis	...	...	*	*	?	...	...	...	...	...	...	*	...	...	3
C. bartonii	...	*	...	...	...	*	...	...	...	...	...	...	*	...	3
C. bartonii acuminatus	...	...	...	...	...	...	...	...	...	...	...	...	*	...	1
C. bartonii carinirostris	...	*	...	...	...	*	...	...	...	...	...	...	*	...	3
C. bartonii robustus	...	...	...	...	...	*	...	...	...	...	...	...	...	...	1
C. bartonii tenebrosus	...	...	...	...	...	...	...	...	...	...	...	...	*	...	1
C. bartonii veteranus	...	*	...	...	...	...	...	...	...	...	...	...	*	...	2
C. blandingii acutus	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. clarkii	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. diogenes	...	...	...	...	...	...	...	...	...	*	...	...	*	...	2
C. diogenes ludovicianus	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. dubius	...	*	...	...	...	...	...	...	...	...	...	...	*	...	2
C. gallinas	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. hagenius	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. immunis	...	...	...	...	...	...	...	...	...	*	...	...	...	...	1
C. latimanus	...	...	...	...	...	...	...	...	...	...	...	...	*	...	1
C. mexicanus	...	...	...	...	...	...	...	*	...	...	...	...	...	...	1
C. obscurus	...	*	...	...	...	*	...	...	...	...	...	...	...	...	2
C. pellucidus	...	...	...	...	...	...	...	...	...	...	...	...	*	...	1
C. propinquus	*	...	...	...	...	...	...	...	...	...	*	...	*	...	3
C. rusticus	*	...	...	...	...	...	*	...	*	...	...	...	*	...	4
C. virilis	...	...	...	...	...	...	...	...	...	...	*	...	*	*	3
Total, 22	2	5	1	1	1	4	1	1	1	7	2	1	12	1	...

EXPLANATION OF PLATES.

PLATE 10.

FIG. 1.—Cross section of body of *Xironogiton oregonensis oregonensis* Ellis, in segment V, showing the butress-like supports of the intersegmental partition. The positions of these structures are indicated by the dotted lines. AC=alimentary canal.

2.—Sagittal section of the head of *Xironogiton oregonensis oregonensis* Ellis, from Eugene, Oregon.

a=first dorsal pharyngeal diverticulum.
b=second dorsal pharyngeal diverticulum.
c=ventral pharyngeal diverticulum.
d=lumen of the pharynx.
e=false diverticulum formed by the contraction of the specimen during fixation.

3.—Side view of type-specimen of *Cambarincola vitrea* Ellis, from Douglas Lake, Michigan.

PLATE 11.

FIG. 1.—Side view of type-specimen of *Pterodrilus durbini* Ellis, from White River, Irondale, near Anderson, Indiana.

2.—Dorsal view of type-specimen of *Xironodrilus formosus* Ellis, from White River, Irondale, near Anderson, Indiana.

3.—Side view of type-specimen of *Cambarincola inversa* Ellis, from Eugene, Oregon.

PLATE 12.

FIG. 1.—Ventral view of type-specimen of *Xironogiton oregonensis oregonensis* Ellis, from Eugene, Oregon.

2.—Dorsal view of type-specimen of *Xironogiton occidentalis* Ellis, from Crab Creek, Washington.

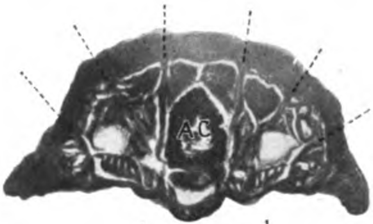
3.—Ventral view of type-specimen of *Xironogiton oregonensis pectinatus* Ellis, from Sequallitchew Lake, Washington.

PLATE 13.

FIG. 1.—Ventral view of *Xironogiton instabilius* (Moore) from Queens, West Virginia. Contracted specimen.

2.—Dorsal view of *Xironodrilus pulcherrimus* (Moore), from Right Hand Fork of Chenowith Creek, Queens, West Virginia.

3.—Ventral view of *Xironogiton instabilius* (Moore), from Queens, West Virginia. Partly expanded specimen.



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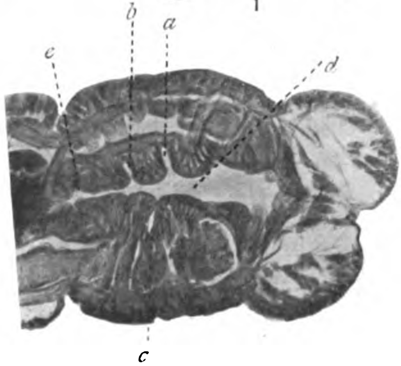

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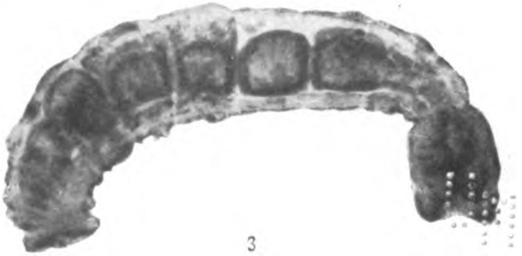
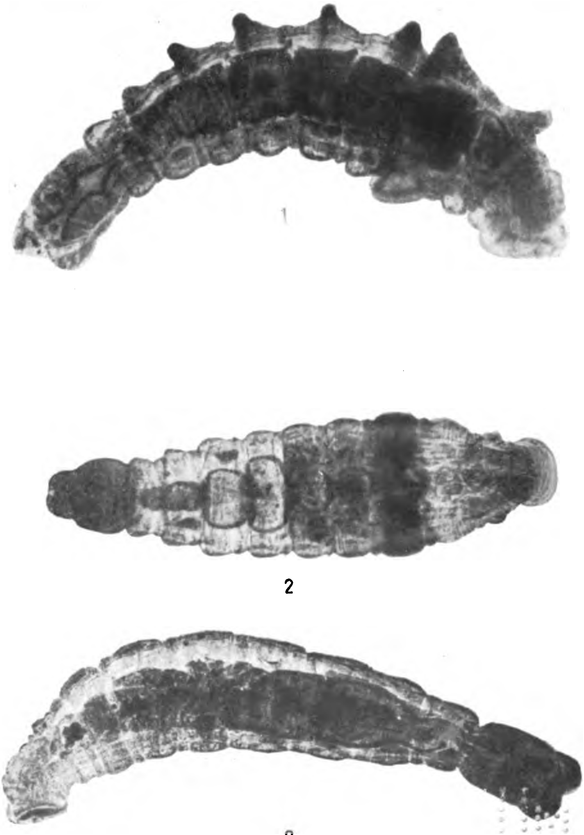


3

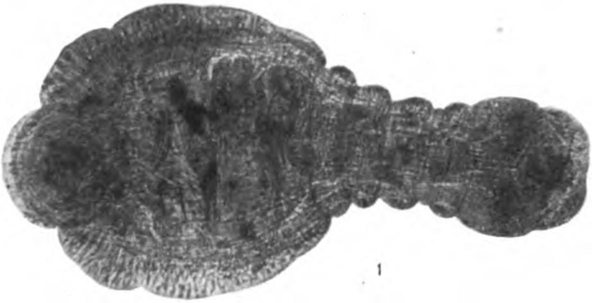
NEW SPECIES OF BRANCHIOBDELLID WORMS.

FOR EXPLANATION OF PLATE SEE PAGE 264.



NEW SPECIES OF BRANCHIOBDELLID WORMS.

FOR EXPLANATION OF PLATE SEE PAGE 265.



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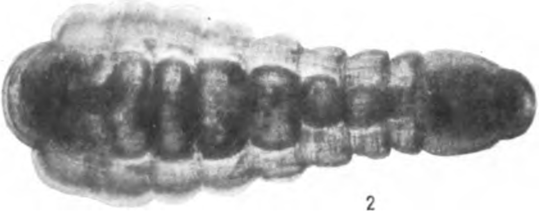

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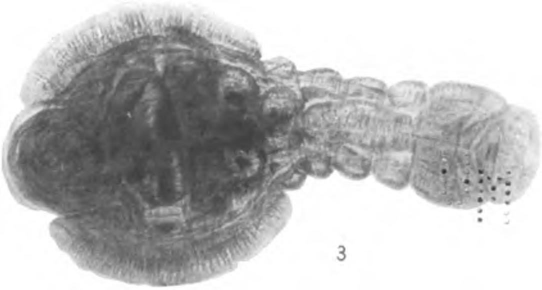

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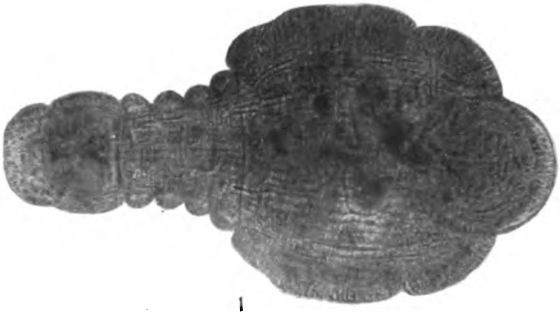
NEW SPECIES OF BRANCHIOBDELLID WORMS.

FOR EXPLANATION OF PLATE SEE PAGE 265.



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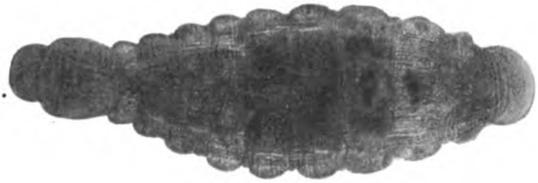

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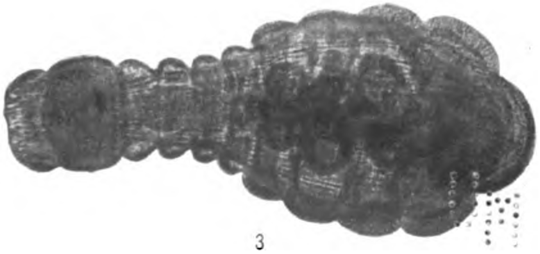

3

NEW SPECIES OF BRANCHIOBDELLID WORMS.

FOR EXPLANATION OF PLATE SEE PAGE 265.

NOTES ON BIRDS COLLECTED BY DR. W. L. ABBOTT ON PULO TAYA, BERHALA STRAIT, SOUTHEASTERN SUMATRA.

By Harry C. Oberholser.

Of the Biological Survey, United States Department of Agriculture.

Pulo Taya, or the island of Taya,[1] as it is sometimes called, is situated at the eastern end of Berhala Strait. This makes it about 30 miles south of the eastern end of Lingga Island, about the same distance southeast of Singkap Island, and slightly farther from Cape Bon, the nearest point on the southeastern coast of Sumatra. The island is oval in shape, about one and one-half miles in length from north to south, by three-quarters of a mile in width; is of granitic formation; and has some coral reefs. The shore is steep, and a double peak rises inland to a height of 630 feet. There is an excellent spring on the western side. Pulo Taya is uninhabited, but fishermen from Singkap Island visit it to snare the Nicobar pigeons. It is wholly forested, and birds seem to be fairly numerous, though of few species. The presence of a few rats and squirrels is reported by natives of neighboring islands.

Two small islands, the Nyamok Islets, lie about a mile off the northern end of Pulo Taya. The larger of these is only some 200 or 300 yards long, and about 10 acres in extent; and neither is over 150 feet high. They support a thin growth of jungle, but their bird life, so far as observed by Dr. W. L. Abbott, is, except for *Caloenas nicobarica*, almost negligible. Because of their close proximity these islets are included in the present paper on the avifauna of Pulo Taya.

Doctor Abbott visited Pulo Taya and the Nyamok Islets from July 26 to July 28, 1899. His collection of birds, which, as usual, he presented to the United States National Museum, numbered 30 specimens, two of which, sunbirds, have subsequently disappeared. The remaining 28 represent 8 species, and include three new subspecies, two of which, herewith described, are apparently endemic. The other, of wider geographic range, has already been named in another paper.[2] In addition to the birds collected by Doctor Abbott, there are included in the following list two species, designated by an asterisk (one of them on only the Nyamok Islets), which were merely seen. Aside from the two endemic forms, the known avifauna of Pulo Taya appears not to differ from that of Lingga and other neighboring islands.

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[1] Saja Island of some maps.

[2] *Sauropatis chloris cyanescens* Oberholser, Proc. U. S. Nat. Mus., vol. 52, February 8, 1917, p. 189 (Pulo Taya, off the southeastern coast of Sumatra).

Doctor Abbott, accompanied by Mr. C. Boden Kloss, was apparently the first ornithologist to examine Pulo Taya. References in literature to its birds, therefore, are confined to papers mentioning the results of this expedition.

Mr. Kloss has published a popular account of the trip,[1] in which he mentions some birds; and the present writer has described a subspecies of *Sauropatis chloris* from Pulo Taya specimens.[2]

I am indebted to Doctor Abbott for physiographical and other notes concerning the islands here treated; and to Dr. C. W. Richmond for other assistance.

Measurements in this paper are all given in millimeters, and have been taken as explained in the author's paper on *Butorides virescens*.[3] The names of colors are from Mr. Robert Ridgway's recently (1913) published Color Standards and Color Nomenclature. The locality of all specimens hereinafter treated should be understood as Pulo Taya unless otherwise stated.

Family ARDEIDAE.

*DEMIGRETTA SACRA SACRA (Gmelin).[4]

[*Ardea*] *sacra* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 640 (Tahiti Island, Society Islands).

A pair was seen on the Nyamok islets.

Family PANDIONIDAE.

*POLIOAETUS ICHTHYAETUS (Horsfield).

Falco Ichthyœtus HORSFIELD, Trans. Linn. Soc. Lond., vol. 13, May, 1821, p. 136 (Java).

One fish eagle, without much doubt this species, was seen on Pulo Taya by Doctor Abbott.

Family LARIDAE.

STERNA MELANAUCHEN MELANAUCHEN Temminck.

Sterna melanauchen TEMMINCK, Nouv. Rec. Planch. Col. d'Ois., vol. 5, livr. 72, 1827, pl. 427 and text (coast of Celebes).

Three specimens, from Pulo Taya, where Doctor Abbott reports the species "pretty common." They are all adults, with some of the wing-quills in process of molt. Concerning the females, Doctor

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[1] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, pp. 58–59.

[2] *Sauropatis chloris cyanescens* Oberholser, Proc. U. S. Nat. Mus., vol. 52, February 3, 1917, p. 189.

[3] Proc. U. S. Nat. Mus., vol. 42, 1912, p. 533.

[4] Species designated by an asterisk are not represented by specimens.

Abbott says: "Iris dark brown; feet dark brown; bill black; extreme tip white." In size and color these birds agree with those from the Philippine Islands and China. They measure as follows:

Measurements of specimens of Sterna melanauchen melanauchen.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Bill from gape.	Tarsus.
			1899.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
170820	Male..	Pulo Taya....	July 28	Dr. W. L. Abbott.	355.6	229	150	35	47	20
170821	Female	.....do.........	...do.....	.....do.........	330.2	....	129	33	42	18
170822	Female	.....do.........	...do.....	.....do.........	342.9	....	136.5	33.7	44.5	18.5

[a] Measured in the flesh by the collector.

STERNA ANAETHETA ANAETHETA Scopoli.

Sterna anaethetus SCOPOLI, Del. Flor. et Faun. Insubr., pt. 2, 1786, p. 92 (Panay Island, Philippine Islands).

One adult female of this species, No. 170819, U.S.N.M., is in the collection, taken on July 26, 1899. Length in flesh, 394 mm. "Bill and feet black; iris dark brown." It is identical with examples from the Tambelan Islands. Doctor Abbott mentions that this bird had a tumor on the angle of its jaw.

Family CLARAVIIDAE.

CALOENAS NICOBARICA (Linnaeus).

[*Columbia*] *nicobarica* LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 164 (Nicobar Islands, Bay of Bengal).

Five specimens:

Adult female, No. 170827, U.S.N.M., Pulo Taya, July 28, 1899. Length in flesh, 368.5 mm. "Iris brownish gray; bill and cere dull black; feet livid purple, claws yellow."

Juvenal female, No. 170830, U.S.N.M.; Pulo Taya, July 28, 1899. Length in flesh, 355.5 mm. "Middle of bill leaden, base and cere and tip black; feet dark brown, claws pale brown."

Adult male, No. 170828, U.S.N.M.; Pulo Taya (obtained in captivity on Lingga Island, July 24, 1899). Length in flesh, 368.5 mm. "Iris dark gray; bill and cere dull black; feet dark purple, soles yellow."

Adult female, No. 170831, U.S.N.M.; Pulo Taya (obtained in captivity on Lingga Island, July 24, 1899). Length in flesh, 355.5 mm. "Bill and cere dull black; feet dark purple; soles yellow."

Adult female, No. 170829, U.S.N.M.; Pulo Taya (bought in captivity on Lingga Island, July 21, 1899). Length in flesh, 355.5 mm. "Iris dark gray; bill and cere bluish black; legs livid purple; soles yellowish."

The juvenal female differs from the adult in its much more bronzy interscapulum; rudimentary hackles on the hind neck; duller posterior upper parts and wings; much duller, more bronzy lower surface; and lack of hackles on the foreneck.

Doctor Abbott reported having seen a few Nicobar pigeons on Pulo Taya, but many more on the Nyamok Islets.

Family COLUMBIDAE.

COLUMBA ARGENTINA Bonaparte.

[*Myristicivora*] *grisea* BONAPARTE, Consp. Gen. Avium, vol. 2, 1854, p. 36 (Gray MS.) (Indian Archipelago).

Columba argentina BONAPARTE, Consp. Gen. Avium, vol. 2, 1854, p. 36 (Temminck MS.) (substitute name for *Myristicivora grisea* Bonaparte [in synonymy]).

Columba phasma RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 490 (new name for *Myristicivora grisea* Bonaparte, not *Columba grisea* Bonnaterre 1790).

A single adult female of this rare pigeon was obtained by Doctor Abbott on Pulo Taya, July 27, 1899. The colors of the soft parts are given as follows: "Iris pink; feet pale purple; bill greenish horny at tip; base and cere dull brownish purple." Length in flesh, 406.5 mm. The plumage, both above and below, is somewhat adventitiously stained with brownish.

Dr. Charles W. Richmond some time ago called attention to the preoccupation of the name *Columba grisea* as used for this species, and proposed *Columba phasma* in its place.[1] Unfortunately, however, the term *Columba argentina* (a manuscript name from Temminck), inserted tentatively by Bonaparte as a synonym of his *Myristicivora grisea*,[2] becomes thus a substitute name for the latter. Since, therefore, the specific name *grisea* can not be used in the genus *Columba*, on account of the previous *Columba grisea* Bonnaterre,[3] for a South American species of *Chaemepelia*, the bird heretofore called *Columba grisea* (Bonaparte) must now be known as *Columba argentina* Bonaparte.

This species was first named *Carpophaga grisea* by G. R. Gray,[4] from a specimen in the British Museum collected in the "Indian Archipelago." This example is now preserved in the British Museum, and should be considered, as already done by Count Salvadori,[5] the type of Bonaparte's name *Myristicivora grisea*, and hence of the species, since both the two other names applied to this pigeon, *Columba argentina* Bonaparte and *Columba phasma* Richmond, must be treated as merely substitute terms. The type-locality of the species is consequently the Indian Archipelago.

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[1] Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 490.

[2] Consp. Gen. Avium, vol. 2, 1854, p. 36.

[3] Encyl. Méth., pt. 1, 1792, p. 252 (Cayenne).

[4] List Spec. Birds Coll. Brit. Mus., pt. 3, Gallinae and Anseres, 1844, p. 5 (*nomen nudum*).

[5] Cat. Birds Brit. Mus., vol. 21, 1893, p. 249.

Family TRERONIDAE.

MYRISTICIVORA BICOLOR (Scopoli).

Columba bicolor SCOPOLI, Del. Flor. et Faun. Insubr., pt. 2, 1786, p. 94 (New Guinea).

Four specimens:

Adult female, No. 170823, U.S.N.M.; Pulo Taya, July 27, 1899.

Adult female, No. 170824, U.S.N.M.; Pulo Taya, July 27, 1899. "Iris dark brown; bill leaden blue, black at tip; feet pale blue."

Adult female, No. 170825, U.S.N.M.; Pulo Taya, July 27, 1899. "Bill leaden blue, black [at] tip; feet light blue; claws black."

Adult female, No. 170826, U.S.N.M.; Pulo Taya, July 27, 1899. "Iris dark brown; eyelids leaden."

All these examples, as is so frequently the case with this species, are more or less adventitiously stained, apparently by fruit juices, about the head, and some of them also on the under parts. They apparently do not differ in either color or size from specimens of this species taken in other localities. Doctor Abbott found this pigeon numerous on Pulo Taya. Measurements of the specimens collected are given herewith:

Measurements of specimens of Myristicivora bicolor.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
			1899.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
170823	Female	Pulo Taya....	July 27	Dr. W. L. Abbott.	381	222	121	24.5	8	29	34.5
170824	...do...	.....do.........	...do...	.....do........	375	221	116.5	20.5	7	29	32.5
170825	...do...	.....do.........	...do...	.....do........	381	222	127	22.5	8.5	29	32.5
170826	...do...	.....do.........	...do...	.....do........	387	219	117	24	9	31	34

[a] Measured in the flesh by the collector.

Family ALCEDINIDAE.

SAUROPATIS CHLORIS CYANESCENS Oberholser.

Sauropatis chloris cyanescens OBERHOLSER, Proc. U. S. Nat. Mus., vol. 52, February 8, 1917, p. 189 (Pulo Taya, off the southeastern coast of Sumatra).

Four specimens:

Adult male, No. 170835, U.S.N.M., type of subspecies; July 28, 1899. Length in flesh, 260 mm.

Adult female, No. 170836, U.S.N.M.; July 28, 1899. Length in flesh, 270 mm. "Iris dark brown; bill black, white beneath at base; claws black."

Adult female, No. 170833, U.S.N.M.; July 27, 1899. Length in flesh, 273 mm. "Iris dark brown; bill black, fleshy white beneath at base; feet dark brown, soles pale."

Adult female, No. 170834, U.S.N.M.; July 28, 1899. "Iris dark brown; bill black, white beneath at base."

One of these (No. 170836, U.S.N.M., July 28, 1899) is just beginning to show molt in the wings and tail.

According to Doctor Abbott this kingfisher was fairly common on Pulo Taya; and Mr. Kloss reported it from the Nyamok Islets.[1]

Family GRACULIDAE.

LAMPROCORAX PANAYENSIS RICHMONDI, new subspecies.[2]

Subspecific characters.—Resembling *Lamprocorax panayensis strigatus*, from Java, but decidedly larger; green of particularly the lower parts more bronzy or yellowish (less bluish).

Description.—Type, adult male, No. 170841, U.S.N.M.; Pulo Taya, July 27, 1899; Dr. W. L. Abbott. Upper and lower parts shining metallic yew green, the former with a very slight, the latter with a very decided, purplish bronzy sheen; tail browish black, the three middle pairs of rectrices and broad exterior margins of the rest, metallic dull blue green; wings brownish black, the inner edges of the quills paler and more brownish, both webs of tertials, with outer webs of primaries and secondaries, metallic dull blue green; greater wing-coverts metallic dusky yellowish green; median and lesser wing-coverts like the back; under wing-coverts fuscous black edged with metallic dull bluish green.

This new race is decidedly larger than Malay Peninsula specimens of *Lamprocorax panayensis affinis*, especially in the bill, and is usually more bronzy below. It is, in fact, most closely related to *Lamprocorax panayensis heterochlorus*[3] of the Anamba Islands, but is separable by its smaller size, particularly shorter tail, and by its more bronzy plumage, especially below. So far as known, it is confined to Pulo Taya.

The reasons for the recognition of the genus *Lamprocorax* as distinct from *Aplonis* have already been set forth by the present writer.[4]

Doctor Abbott reported *Lamprocorax panayensis richmondi* fairly common on Pulo Taya at the time of his visit, and collected six specimens there, as follows:

Adult male, type, No. 170841, U.S.N.M., July 27, 1899.

Adult male, No. 170837, U.S.N.M.; July 26, 1899. "Iris red; bill and feet black."

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[1] Journ. Straits Branch Roy. Asiatic Soc., No. 41, January, 1904, p. 59.

[2] Named in honor of Dr. C. W. Richmond, who first discovered its distinctness.

[3] *Lamprocorax panayensis heterochlorus* Oberholser, Bull. U. S. Nat. Mus., No. 98, June 30, 1917, p. 57.

[4] Bull. U. S. Nat. Mus., No. 98. June 30. 1917. p. 58.

Juvenal male, No. 170838, U.S.N.M.; July 26, 1899. Length in flesh, 216 mm.

Juvenal female, No. 170839, U.S.N.M.; July 26, 1899. Length in flesh, 203 mm. "Iris red; bill and feet black."

Juvenal female, No. 170840, U.S.N.M.; July 27, 1899. Length in flesh, 203 mm.

Juvenal female, No. 170842, U.S.N.M.; July 27, 1899. Length in flesh, 203 mm.

Two of the juvenal females (Nos. 170839 and 170842, U.S.N.M.) are just beginning to molt; the two other juvenal birds are in the midst of the process, this affecting both quills and contour feathers, and have acquired a considerable portion of their adult livery. Measurements of the two adults are as follows:

Measurements of specimens of Lamprocorax panayensis richmondi.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
			1899.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
170841	Male.	Pulo Taya [b] ...	July 27	Dr. W. L. Abbott.	....	108	69	18.5	7.5	22	18.5
170837	..do..	.....do..........	July 26	.....do........	222	107	69	18	7.5	22	19.5

[a] Measured in the flesh by the collector. [b] Type.

Family NECTARINIIDAE.

CINNYRIS ORNATA MICROLEUCA, new subspecies.

Subspecific characters.—Similar to *Cinnyris ornata ornata* (=*Cinnyris pectoralis* [Horsfield])[1] from Java, but decidedly larger; male with upper parts less golden (more grayish or brownish); posterior lower surface averaging paler; outer pair of rectrices with smaller white tips. Female also less golden (more grayish or brownish) above than the same sex of *Cinnyris ornata ornata*, with posterior lower parts averaging somewhat paler, and the outer rectrices with less white on their tips.

Description.—Type, adult male, No. 170843, U.S.N.M.; Pulo Taya, off the southeastern coast of Sumatra, July 26, 1899; Dr. W. L. Abbott. Sinciput metallic dusky violet blue; rest of upper surface citrine, the rump and upper tail-coverts more yellowish; tail brownish black, the three outer rectrices tipped with white, most broadly on the outermost; wings fuscous, the quills and all the coverts, except the primary series, narrowly margined externally with citrine; center of chin, throat, and jugulum, raisin black; sides of chin, throat, and jugulum, with lores and anterior part of cheeks, metallic indigo blue; remainder of sides of head and sides of neck, citrine; a narrow somewhat broken line across the breast at the posterior edge of the raisin black jugulum, prout's brown; pectoral tufts cadmium yellow; breast and abdomen, chrome yellow; lower tail-coverts between wax yellow and primuline yellow; sides of body and thighs wax yellow; lining of wing white washed with baryta yellow; "bill and feet black."

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[1] For this change of name, see Oberholser, Smithson. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 18.

Of the three adult males from Pulo Taya, the one chosen as the type is somewhat the dullest and least golden above; otherwise the individual difference is but slight. Doctor Abbott says that the species was tolerably common on Pulo Taya, where it frequents the jungle. So far as known, this new subspecies is confined to this island. Measurements of four adults are as follows:

Measurements of specimens of Cinnyris ornata microleuca.

U.S.N.M. No.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
			1899.		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
170843	Male..	Pulo Taya[b] ..	July 26	Dr. W. L. Abbott.	114	54	31.5	17	14.5	9.5
170844	...do...	.....do.........	July 27	.....do.........	121	54	34	....	14	9.5
170848	...do...	.....do.........	July 28	.....do.........	108	54.5	32.5	18	14.5	8
170845	Female	.....do.........	July 27	.....do.........	108	48.5	31	16.5	13.5	9

[a] Measured in the flesh by the collector.

[b] Type.

HEMIPTERA COLLECTED BY THE YALE-DOMINICAN EXPEDITION OF 1913.

By Edmund H. Gibson.

Custodian of Hemiptera, United States National Museum.

The specimens as listed below were collected by Mr. H. W. Foote during June, 1913, from the Island of Dominica. One new species is included.

Order HEMIPTERA.

Suborder HETEROPTERA.

Family SCUTELLERIDAE.

ANGOCORIS PALLIDUS Herrick Schäffer.

One female.

Family PENTATOMIDAE.

MORMIDAE YPSILON Linnaeus.

Seven females and one male.

EUSCHISTUS BIFIBULUS Palisot de Beauvois.

Two females.

PROXYS VICTOR Fabricius.

One female.

LOXA VARIEGATA Distant.

One female.

NEZARA VIRIDULA Linnaeus.

Two females.

NEZARA MARGINATA Palisot de Beauvois.

Two females.

BANASA VARIANS Stal.

One female.

EDESSA CORNUTA Burmeister.

One female and two males.

EDESSA MEDITABUNDA Fabricius.

Two females.

Family COREIDAE.

ACANTHOCERUS CLAVIPES Fabricius.

One male.

SPARTOCERA BATATAS Fabricius.

One male.

ANASA BELLATOR Fabricius.

Two females and one male.

ALYDUS PALLESCENS Stal.

One female.

Family LYGAEIDAE.

ONCOPELTUS FASCIATUS Dallas.

Five males.

OZOPHORA CONSANGUINEA Distant.

One female.

OZOPHORA PALLESCENS Distant.

One male.

Family REDUVIIDAE.

ZELUS RUBIDUS Guerin.

One female and three males.

Two males from the Island of Guadaloupe.

Suborder HOMOPTERA.

Family CICADIDAE.

PROARNA HILARIS Germar.

Two females.

Family MEMBRACIDAE.

MICRUTALIS CALVA Say.[1]

One female.

DARNOIDES NIGROAPICATA Stal.[1]

One male and one female.

Family CERCOPIDAE.

TOMASPIS DOMINICANA Distant.[2]

Two females and one male.

CLOVIA MODESTA, new species.

Head only slightly narrower than greatest width across the pronotum. Vertex one-half as long as broad and considerably concave or scooped as viewed from the side, anterior margin next to eyes very thin, thick at the middle. Front swollen, clypeus short and broad. Eyes large, ocelli small and placed closer together than the distance between an eye and ocellus. Ocelli are situated the length of their diameters from the posterior border of vertex. Pronotum well rounded in front, lateral borders short but with a prominent carina which is light in color, posterior border two lobed. Callosites more or less prominent. Pronotum with irregular wavy impressed transverse lines. Scutellum longer than broad and very acutely pointed. Elytra slightly surpassing the abdomen and densely punctate, veins indistinct; clavus broad, claval suture deep. Abdomen short. Genitalia comparatively short. Male plates narrow. Tibia armed with two prominent spurs on underside.

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[1] Determined by Mr. W. D. Funkhouser.

[2] Tentative determination by Prof. Herbert Osborn. Verified by the author.

Color, above chestnut to dark brown. Apex of head yellowish. Entirely covered above with a fine golden or yellow pubescence, which appears whitish in three small spots on the elytra. Dark beneath, posterior legs light.

Size: 4.6 mm. long, 2 mm. wide.

Type.—Cat. No. 21719, U.S.N.M.

Described from a single male specimen which is deposited in the collection of the United States National Museum. This specimen was submitted to Prof. Herbert Osborn who identified it as a new species and advised me to consider it as belonging to the genus *Clovia* although the genus has no other representation in the Western Hemisphere. If more specimens could be examined it might prove necessary to erect a new genus to include this species.

Family CICADELLIDAE.

TETTIGONIA OCCATORIA Say.

One male.

TETTIGONIA PROLIXA Fowler.

Two females.

TETTIGONIA PSITTACELLA Fowler.

One female.

Famiy FULGORIDAE.

TANGIA ANGULATA Uhler.

One female.

CUBANA TORTRIX Uhler.

One male.

CIXIUS, species.

One damaged specimen.

THIONIA VARIEGATA Stal.

Two females and four males.

MIOCENE FOSSIL PLANTS FROM NORTHERN PERU.

By Edward W. Berry,
Of the Johns Hopkins University, Baltimore.

INTRODUCTION.

The present brief paper is based upon a small collection of fossil plants recently received in exchange from the Boston Society of Natural History through the courtesy of Dr. Joseph A. Cushman, and presented by me to the United States National Museum. This collection was made by C. F. Winslow early in the year 1875, and in an interesting letter dated the 3d of March of that year he states that it was made from a clay lens overlying a bed of lignite in the petroleum-bearing sands about 20 miles south of the town and river of Tumbez, and 200 or 300 feet inland from the shore of the Pacific.

In spite of the lack of geological work or satisfactorily accurate maps of this region it is fortunately possible to locate this plant bearing outcrop with sufficient precision to show that it is very near to, if not identical with, the locality from which the described section quoted on a subsequent page was made. The foliage of a luxuriantly wooded region was evidently accumulated in shallow pools, possibly continental, but more probably lagoonal in character, which seasonally, if not for longer intervals, received only very fine muddy sediments. The leaves are consequently in matted layers, with only thin films of mud between them, and hence no one except an experienced collector could be expected to obtain satisfactory material for study.

While the collection described in the following pages leaves much to be desired from the point of view of the correct botanical determination of the species, Mr. Winslow deserves great credit for his interest and for the enterprise with which he succeeded in preserving this material and thus bringing to light this page of geological history, and I can only hope that he is still alive and may see this belated appreciation of his efforts of over 40 years ago.

From the standpoint of the systematic botanist the present study is far from satisfactory, and the difficulty of identifying such fragmentary material has led me to accept the determinations of previous workers on the paleobotany of South America without attempting to revise their generic references, although I am fully conscious that some at least of these are faulty.

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The principal interest in the present paper must be the decisive evidence which it furnishes of the very different climatic conditions formerly existing in this desert region and the rather far-reaching correlations which it is possible to make—results which in both cases are not at all dependent on the correct botanical determination of the species. Before discussing these results it would be profitable to consider briefly the present climatic and physiographic features of this section of Peru. Physiographically Peru may be divided into three well-defined longitudinal regions: (1) The Coast region of sandy arid desert or semidesert, crossed by rivers in narrow, more or less fertile valleys according to the water supply; (2) the Sierra or Andean region, which I need not stop to characterize; and (3) the Montaña, or region of tropical forests of the Amazon basin.

In northern Peru the Piura desert extends along the coast from the Gulf of Guayaquil southward to the Morrope Valley, a distance of about 200 miles. It is traversed by three rivers—the Tumbez, Chira, and Piura—the first two having their sources in the inner Cordilleras and hence not dry part of the time. The climate is less arid than farther south, fogs and garuas are more frequent, and at intervals of several years there are occasional heavy showers. The country is practically treeless. The valleys contain chaparral of *Prosopis*, and along the river banks willows and groups of palms; and the irrigated cultivation of cotton, cane, corn, alfalfa, and vineyards is possible where the streams are of sufficient size and not intermittent.

I might add that the entire sea border of Peru is a semidesert, Arica dividing the true rainless desert country of Chile from the sterile country extending northward from Arica (latitude 18° 30′) to north of Tumbez (latitude 3° 20′), which, though normally rainless, as just stated, receives the benefit of the drizzly garuas and sea fogs which are reflected in the less pronounced desert character of this northern country.

Beginning with John Ball[1] the flora of the Coastal zone of western South America has been discussed by von Eggers[2], Wolff[3], and Guppy[4]. The Strand is characterized as the Sesuvium zone, replaced some distance north of Tumbez by the Mangrove zone of the Gulf of Guayaquil.

The region immediately behind the beach from Tumbez southward is a typical desert or semidesert, consisting of sand-covered barren hill slopes with shifting dunes (mendanos) and varied only in the transverse valleys by vegetation more fitting to the latitude. About 25 or 30 miles northeast of Tumbez there is a remarkably sudden change in the coastal flora. At Puerto Bolivar, in the Ecuadorian Province of Eloro, the mangrove belt extends inland from the beach for about 2 miles. The "mangle chico" fronts the sea and passes gradually into the "mangle grande," where the Rhizophores are 70 or 80 feet tall and draped with *Tillandsia.* In the rear of the zone of tall mangrove the swamp becomes more open, with small trees of *Rhizophora*, *Laguncularia*, and *Avicennia*, and scattered areas of the shrubby *Salicornia peruviana.* At about 2 miles from the sea the swamp passes over into a region of naked, sun-caked, and salt-incrusted mud flats traversed by salt-water creeks bordered by low shrubby *Rhizophora*, *Avicennia*, and *Salicornia.* These mud flats, submerged only by the spring tides, form a belt here somewhat over a mile in width, and pass gradually into the sandy arid saliferous Machala plains with cacti, *Prosopis*, and scattered thorny shrubs and dwarfed trees.

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[1] Ball, J., Notes of a Naturalist in South America, London, 1887.

[2] Eggers, H. von, Das Küstengebiet von Ecuador. Deutsche Geogr. Blätter, vol. 17, Heft 4, 1894.

[3] Wolff, T., Geografía y Geología del Ecuador, 1892.

[4] Guppy, H. B., A Naturalist in the Pacific, vol. 2, pp. 474–501, 1906.

A good account of the estuary flora of the Santa Rosa River near Puerto Bolivar is given by Guppy.[1] From this point northward to the head of the Gulf of Guayaquil the vegetation passes by degrees into the normal tropical estuary flora. Villavicencio, Wolff, Webster, Guppy, and others believe that the costal region is still becoming progressively more sterile, and since Darwin's day we have had evidence of coral masses and elevated shell beds pointing to a former lower level of the land and, presumably to be correlated with this, a more humid climate. Suess suggested[2] that this might be due to the formation of the Isthmus of Panama and the appearance of the Humboldt current. Since, however, the waters of the Atlantic and the Pacific have freely mingled at many times during geologic history, and as we as yet know comparatively little of the Tertiary history of South America, it is not possible to discuss these interesting problems with profit.

Aside from the description of a few species of Tertiary marine fossils by d'Orbigny,[3] Nelson,[4] and Gabb,[5] the general work of Raimondi,[6] and incidental references in Darwin's Voyage of the *Beagle*,[7] the only detailed account of the geology of any locality in this part of Peru is based on a reconnoissance of Josef Grzybowski, of Cracow, who spent a week around Tumbez and Paita in 1898 and who subsequently published[1] a description of the Mollusca collected and some notes upon the geology.

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[1] A Naturalist in the Pacific.

[2] Das Antlitz der Erde, vol. 2, p. 825.

[3] d'Orbigny, A., Paléontologie due Voyage l'Amerique méridionale, Paris, 1842.

[4] Nelson, E. T., On the Molluscan fauna of the later Tertiary of Peru. Trans. Conn. Acad., vol. 2, pt. 1, 1870.

[5] Gabb, W. M., Description of a collection of fossils, made by Dr. Antonio Raimondi in Peru, Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 8, pp. 263–336, pls. 35–43, 1877.

[6] Raimondi, A., El Perú, vol. 4, Estudiós mineralógicos, Lima, 1902.

[7] Although devoted to the region farther south, the recently published work by Bowman on The Andes of Southern Peru (Amer. Geogr. Soc., 1916) gives an admirable discussion of the broader aspects of the physiographic history and climatic features of the Peruvian region.

In addition to an intrusive granite and a phyllite of unknown age and some Paleozoic schists, conglomerates and limestones, he distinguishes five stages of the Tertiary—namely, the Paita, Talara, Zorritos, Heath, and Ovibio. The only one of these that is of importance in the present connection is the Heath stage, named from a small dry stream valley known as Quebrada Heath. From the vicinity of Caleta Grau he describes the following section:

Conglomerate with petrified wood capping the hills.
Sandstone, 40 meters.
Finer grained hard dark sandstone, 10 meters.
Red shale, 12 meters.
Dark clays with traces of fossil plants, 2 meters.
Dark platy argillaceous lignite, 80 centims to 1 meter.
Brown bituminous clay with traces of plants.
Oyster bank, 80 centims.
Bituminous gypsiferous shales.

The strata are both folded and faulted in a direction roughly paralled with the coast. From the sandstone in the foregoing section he collected the following marine invertebrates:

Arca larkinii Nelson.
obesiformis Grzybowski.
Turritella altilirata Conrad.
Pyrula roseta Grzybowski.
Puncturella phrygia Grzybowski.

From the shales underlying the sandstones he collected:

Ostrea latiareata Grzybowski.
sculpta Grzybowski.
Venus münsteri d'Orbigny.
nelsoni Grzybowski.
Cytherea planivieta Guppy.
affinis Grzybowski.
Cardium subaucanum Grzybowski.
tenuimargo Grzybowski.
Lutraria hortensia Grzybowski.
vetula Philippi.
Dosinia lenticula Grzybowski.
Leda acutisinuata Grzybowski
Turritella filicineta Grzybowski.
Lucina prosoptera Grzybowski.

Venus münsteri and *Lutraria vetula* are common to the Navidad beds of Chile and *Cytherea planivieta* occurs in the Bowden beds of

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[1] Grzybowksi, J., Die Tertiärablagerungen des nördlichen Peru und ihre Molluskenfauna. Neues Jahrb. Beilage, vol. 12, pp. 610–664, pls. 15–20, 1899.

Jamaica. The genera *Lutraria*, *Ostrea*, and *Cardium* have very similar species in the Navidad beds of Chile, while there is a similar species of *Dosinia* in the lower Miocene of Trinidad. Grzybowski rightly considers the Heath stage as of lower Miocene age. He considers the underlying Ovibio stage as Oligocene, the overlying Zorritos stage as lower Miocene, the Talara stage as upper Miocene, and the Paita stage as Pliocene.

BOTANICAL FACIES AND ECOLOGY.

Because of the uncertainty of identification of these fossil plants I will not attempt to describe their botanical facies in the present paper. Quite independently of this they furnish convincing evidence that the coastal region of Peru during the early Miocene was a region covered with a dense tropical forest, including a variety of broad-leaved mesophytic hardwoods mixed with lianas and large feather palms, and that the climate and rainfall were in striking contrast with what they are at the present time in this region. This would seem to indicate that in the early Miocene the Ecuadorian and Peruvian Andes had not yet interposed their bulk in the path of the easterly moisture-bearing trade winds and that the present coastal desert was not in existence.

AGE OF THE FOSSIL FLORA.

The fossil plants described in the following pages number 14 species, of which six are only provisional identifications. Five of the remaining eight definitely determined species are new and do not have a known outside distribution, although one of these new species is believed to be identical with a form described under another name from the Navidad beds of Chile. Each of the three remaining species is found outside of this area, one being common to Panama, a second to Colombia, and the third to Ecuador. The six tentatively identified forms are all common to Colombia, and one of these occurs also in the Navidad beds of Chile.

It thus appears probable, especially as this conclusion is corroborated by the relations of the marine faunas found here and in the Navidad beds, that all of these South American Tertiary plant-bearing deposits approximate one another in age. The extremes of possible difference for these floras that I have specifically mentioned is embraced within the limits of the Chattian, Aquitanian, and Burdigalian stages of the European section. It appears probable that continued comparisons will make possible still more definite correlations of all of these floras.

Regarding the exact age of the Peruvian fossil plants the choice lies between the Aquitanian and the Burdigalian stages, and since the *Guatteria* found here occurs in the Caimito formation of Panama, which is either uppermost Aquitanian or Burdigalian, and since one of the associated Mollusca is common to the Bowden beds of Jamaica, which are unquestionably of Burdigalian age, and others of the Mollusca are closely related to lower Miocene forms from Trinidad or from Chile, I am disposed to consider this Peruvian fossil flora as Burdigalian in age, and I would extend this correlation to the Navidad beds of Chile except for the reason that the latter beds appear to represent more than a single horizon, although they are in part of this age, and in part probably represent older Tertiary horizons.

I hope to publish an analysis of all of the South American Tertiary floras in the near future, and will only say at this time that the flora found in the Loja coal basin in the Ecuadorian Andes is also of Burdigalian age.

FOSSIL FLORA FROM PERU.

MONOCOTYLEDONAE:
- Arecales-Arecaceae—
    - *Iriartites tumbezensis* Berry.
- Arales-Araceae—
    - *Stenospermation columbiense* Engelhardt (?).
- Poales-Poaceae—
    - *Bambusium stübeli* Engelhardt (?).

DICOTYLEDONAE:
- Urticales-Moraceae—
    - *Ficus winslowiana* Berry.
- Ranales-Anonaceae—
    - *Anona winslowiana* Berry.
    - *Guatteria culebrensis* Berry.
- Geraniales-Malpighiaceae—
    - *Banisteria incerta* Berry.
    - Trigoniaceae.
    - *Trigonia varians* Engelhardt (?).
    - Vochysiaceae.
    - *Vochysia retusifolia* Engelhardt (?).
- Sapindales-Anacardiaceae—
    - *Tapirira lanceolata* Engelhardt.
- Thymeleales-Lauraceae—
    - *Mespilodaphne tumbezensis* Berry.
    - *Persea macrophylloides* Engelhardt (?).
- Ebenales-Styracaceae—
    - *Styrax lanceolata* Engelhardt (?).
- Rubiales-Rubiaceae—
    - *Condaminea grandifolia* Engelhardt.

Class MONOCOTYLEDONAE.

Order ARECALES.

Family ARECACEAE.

IRIARTITES, new genus.

This genus is proposed as a convenient-form genus for the remains of fossil palms that appear to belong to the tribe Iriarteae, but whose exact generic identity is uncertain.

Type of the genus.—*Iriartites tumbezensis*, new species.

IRIARTITES TUMBEZENSIS, new species.

Plate 14.

Description.—Feather palms with leaves of large size, the exact dimensions unknown. The fossil material shows much crowded linear-lanceolate rays attached to the upper surface of a stout prominently keeled rachis. The rays are slightly, if at all, narrowed at the base, and have a maximum width in the preserved material of 1.5 cm. Their estimated length is about 30 cm., although it may have been more than this, since no lengths of single rays have been preserved for a greater distance than 15 cm. In the latter, however, no diminution of width is shown in that distance. The rays have entire margins and a keeled and fairly stout midrib. There are about 25 fine, largely immersed, parallel laterals on either side of the midrib, three or four of which, equally spaced, are somewhat thicker than the intervening ones. The texture of the leaf is coriaceous.

No remains of fossil palm leaves exactly like these have heretofore been described. They are exceedingly abundant in the present collection, the clays being packed with broken fragments of rays, and the number of pieces of clay as large as one's hand that are covered with regularly arranged rays indicates that the greater part of leaves several feet in length were preserved and broken up in collecting them. The largest complete fragment that remains is shown on plate 14, two-thirds natural size.

Among existing palms the fossil is most naturally to be compared with the various members of the tribes Geonomiae, Iriarteae, Morenieae, and Bactrideae, and of these I regard the Iriarteae and Morenieae, especially the former, as offering the most likely comparisons. As elaborated by Drude, the Iriarteae comprise five genera and 25 or more species, whose center of maximum development is the upper Amazon region and the Andean valleys in Colombia and Ecuador. Species of Iriartea extend northward to Costa Rica and southward east of the Andes to Bolivia and throughout the Orinoco and Amazon basins. The other existing genera of this tribe, except the genus *Juania* of the Island of Juan Fernandez, are more particularly confined to the Colombian and Ecuadorian Andean valleys and the region of the headwaters of the Amazon.

Engelhardt[1] has described some fragments of a feather palm from beds in the Cauca Valley in Colombia that I regard as of approximately the same age as the Tumbez deposits as *Palmacites*, but these are so fragmentary that adequate comparisons with them are impossible.

Holotype.—Cat. No. 35329, U.S.N.M.

Order ARALES.

Family ARACEAE.

Subfamily MONSTEROIDEAE.

Genus STENOSPERMATION Schott.

STENOSPERMATION COLUMBIENSE, Engelhardt(?)

Stenospermation columbiense ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 26, pl. 5, fig. 2, 1895.

This species was based upon rather characteristic fragments of large, elliptical-lanceolate, leathery leaves with a very stout midrib and petiole and with a typical araceous venation. These were compared by Engelhardt with the leaves of the existing Peruvian species *Stenospermation matthewsii* Schott and S. *pompayense* Schott, as well as with the leaves in the genus *Aspidistra.*

The material from the locality south of Tumbez is less complete than the type material which came from Santa Ana, on the western margin of the Rio Magdalena Valley in Colombia, hence the Peruvian occurrence is queried, although in so far as the material goes it is identical with the type.

The genus *Stenospermation*, not otherwise known in the fossil state, comprises four or five existing species of the humid regions in the sub-Andean Tropics. It is closely related to the genus *Monstera*, whose pinnately divided leaves are familiar in our greenhouses.

Order POALES.

Family POACEAE.

Genus BAMBUSIUM Unger.

BAMBUSIUM STÜBELI, Engelhardt(?)

Bambusium stübeli ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 24, pl. 5, figs. 4, 5, 1895.

This species was based upon stems of a large grass of uncertain generic identity, described by Engelhardt from the Santa Ana locality in Colombia. It is of slight value, and the similar but more fragmentary remains found at the locality south of Tumbez may or may not represent the same species.

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[1] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 40, pl. 4, fig. 8, 1895.

Class DICOTYLEDONAE.

Order URTICALES.

Family MORACEAE.

Genus FICUS Linnaeus.

FICUS WINSLOWIANA, new species.

Plate 16, fig. 2.

Description.—Leaves of medium size, ovate in general outline, with a bluntly pointed apex and base. Length about 10 cm. Maximum width, in the lower half of the leaf, about 4.5 cm. Margins entire, evenly rounded. Texture subcoriaceous. Petiole missing. Midrib stout, prominent on the lower surface of the leaf. Secondaries thin, immersed in the leaf substance; about 9 alternate pairs diverge from the midrib at angles of 45 degrees or more, becoming less ascending toward the apex of the leaf. The secondaries are thin, almost straight, subparallel and subequally spaced. Their tips are joined by an acrodrome vein well within the margin of each side of the lamina. This vein arches slightly from tip to tip of the successive secondaries. The tertiaries are mostly obsolete; where preserved, they are thin, closely spaced, and percurrent.

This species is named in honor of the collector, Mr. C. F. Winslow. It appears to be new, although it is similar to many existing and fossil species of *Ficus*. It shows considerable resemblance to undescribed forms found in the middle and upper Eocene of the southeastern United States, but appears to be perfectly distinct from any fossil forms known from the Tertiary of Panama, Colombia, Ecuador, or Chile.

Several hundred existing species of *Ficus*, showing a wide range of form, are known, and they are especially abundant in the Amazon and the Orinoco basins and throughout the oriental tropics. The number of fossil forms that have been referred to this genus is large, including perhaps 300 species. None are certainly known from the Lower Cretaceous. In the Upper Cretaceous, however, *Ficus* is widespread and abundant, being represented by characteristic fruits as well as leaves, which seemingly indicate a Lower Cretaceous ancestry that is as yet unknown. The cosmopolitanism inaugurated during the Upper Cretaceous continues throughout the Tertiary, during which time there were many species.

Holotype.—Cat. No. 35337, U.S.N.M.

Order RANALES.

Family ANONACEAE.

Genus GUATTERIA Ruiz and Pavon.

GUATTERIA CULEBRENSIS Berry.

Plate 16, fig. 3.

Guatteria culebrensis Berry, U. S. Nat. Mus. Bull. 103, p. 27, pl. 13, fig. 2, 1918.

Description.—Leaves of large size, broadly ovate in general outline, with a narrowed slightly decurrent base and a narrowed and extended acuminate tip. Length about 20 cm. Maximum width, approximately midway between the apex and the base, between 6 cm. and 7 cm. Margins entire. Texture coriaceous. Petiole short and stout, enlarged proximad, about 2.25 cm. in length. Midrib stout and prominent. Secondaries mediumly stout and prominent; about ten opposite to alternate pairs diverge from the midrib at angles ranging from 45 to 60 degrees, sweeping upward in regular ascending subparallel curves and camptodrome in the marginal region. Tertiaries, where visible, percurrent.

This is one of the more abundant and better preserved forms in the Panama Canal Zone occurring in formations that are referred to the Aquitanian and Burdigalian stages by Invertebrate paleontologists. The large size of the leaves usually results in fragmentary specimens, the tip being almost invariably missing. The material from Peru is more broken than that from Panama but there can be little doubt of the identity of the two occurrences.

The present species shows similarities with various existing species of Anonaceae. It is much like *Anona macgravii* Martius of Brazil (Bahia and Pernambuco), Venezuela, French and Dutch Guiana. It is, however, among the various existing species of *Guatteria* that the closest homologies are to be seen. The latter genus contains about fifty existing species of shrubs and trees, exclusively American,[1] and found in Mexico, Central America, tropical South America, and in the northern Andes. The fossil may be compared with a number of the still existing species as, for example, *Guatteria ouregon* Dunal, a large Caribbean tree, and equatorial South American *Guatteria dolichopoda* De Candolle or *Guatteria grandiflora* De Candolle of Central America.

Plesiotype.—Cat. No. 35335, U.S.N.M.

Genus ANONA Linnaeus.

ANONA WINSLOWIANA, new species.

Plate 15, fig. 4.

Description.—Leaves broadly elliptical in outline, with possibly an obtusely pointed apex. Base broadly rounded. Margins entire.

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[1] The Asiatic species of authors are referred to the allied genus *Polyalthia*.

Texture subcoriaceous. Length about 11.5 cm. Maximum width, midway between the apex and the base, about 6.25 cm. Petiole missing. Midrib very stout, prominent on the under surface of the leaf. Secondaries about eight subopposite pairs, stout, prominent, diverging from the midrib at subequal intervals, and wide angles approaching 90 degrees: they curve regularly upward in a subparallel manner and are camptodrome in the marginal region. Tertiaries obsolete.

This is a well marked leaf of a new species of *Anona* much like those found in the lower Eocene (Wilcox group) of southeastern North America, and somewhat similar to the upper Eocene *Anona texana* Berry[1] from the Fayette sandstone of Texas. It is still more similar to two species of *Anona* that have been described by Engelhardt[2] from the Navidad beds (Coronel) of Chile.

The geological history of the genus *Anona* has been reviewed recently[3] and need not be repeated in the present connection. The living species of *Anona* number about 75 forms and they are confined almost exclusively to tropical and subtropical America, although a few species are endemic in tropical Africa. Many of these have leaves almost indistinguishable from those of the present fossil species, although without more complete material of the recent species a detailed comparison is not worth much in the present connection. The bulk of the existing species occur in the northern half of South America, and there are several that are common along the Guayaquil River and in the rain forest country of eastern Peru.

Holotype.—Cat. No. 35330, U.S.N.M.

Order GERANIALES.

Family MALPIGHIACEAE.

Genus BANISTERIA Linnaeus.

BANISTERIA INCERTA, new species.

Plate 16, fig. 1.

Description.—Leaves oval or subelliptical in general form, widest in the middle, with a broadly rounded base and a more narrowly rounded tip. Length between 7 cm. and 8 cm. Maximum width about 5 cm. Margins entire, slightly undulate. Texture subcoriaceous. Petiole missing. Midrib stout, prominent, curved. Secondaries stout, fairly evenly spaced, all but the basal pair alternate; five or six pairs diverge from the midrib at wide angles, curve regularly upward in a subparallel manner and are camptodrome in the marginal region. Tertiaries obsolete.

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[1] Berry, E. W., U. S. Geol. Surv. Prof. Paper 98M, p. 289, pl. 60, fig. 9, 1916.

[2] Englehardt, H., Abh. Senck. Naturf. Gesell., vol. 16, Heft 4, p. 663, pl. 7, figs. 2, 3, 11, 1891.

[3] Berry, E. W., U. S. Geol. Surv. Prof. Paper 91, p. 90, 1916.

This species suggests at first sight some short and broad leaved species of *Ficus*, but the venation is not that of *Ficus*. I am not at all certain that these leaves represent *Banisteria*, although they are very close to a number of existing South American species of that genus, as well as in the allied genus *Tetrapteris*. In addition to this foliar similarity I have been influenced by the presence of undoubted fruits of *Banisteria* in the synchronous and not very distant deposits at Loja in Ecuador.[1] It might be remarked that some of the Bignoniaceae have leaves of this sort as, for example, *Bignonia* and *Fridericia*.

The genus *Banisteria* contains over 70 existing species of climbing or scrambling shrubs, ranging from the Antilles throughout tropical South America and reaching their maximum of development in the rain forests of the Amazon Basin. At least two of the species, *Banisteria populifolia* and *B. caduciflora* are found in the Andean region of Peru,[2] where they inhabit humid valleys below 3,300 feet in elevation. The genus is represented by both leaves and fruits in the fossil state, and it was not uncommon in Europe and southeastern North America during the Tertiary.

Holotype.—Cat. No. 35333, U.S.N.M.

Family TRIGONIACEAE.

Genus TRIGONIA Aublet.

TRIGONIA VARIANS Engelhardt?

Trigonia varians ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 35, pl. 7, figs. 4–6; pl. 9, fig. 9, 1894.

This species was based on fairly complete material, not uncommon at the Santa Ana locality in Colombia, which Engelhardt compared with the existing species, *Trigonia pubescens*, *T. glazioviana*, *T. boliviana*, and *T. mollis*. Fragmentary and not certainly identical remains are contained in the collections from south of Tumbez.

The generic identity of these forms is doubtful, and they suggest the genus *Myristica* to me rather than *Trigonia*. The latter genus has between 25 and 30 existing species, mostly shrubs, and, like the family to which they belong, confined to the equatorial region from Central America to southern Brazil.

Family VOCHYSIACEAE.

Genus VOCHYSIA Jussieu.

VOCHYSIA RETUSIFOLIA Engelhardt?

Vochysia retusifolia ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 34, pl. 7, fig. 3, 1895.

This species was based upon incomplete material from near Santa Ana, in Colombia. The Peruvian material is still more fragmentary, but exhibits a characteristic venation exactly like that of the type. Its reference to the genus *Vochysia* is questionable.

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[1] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 14, pl. 2, figs. 18, 19, 1895.

[2] Weberbauer, A., Die Pflanzenwelt der peruanischen Anden, 1911, pp. 155, 282.

The family Vochysiaceae, like its principal genus, *Vochysia*, is confined to tropical America. *Vochysia* comprises about three score existing species of trees, shrubs, or rarely herbs, with coriaceous leaves, chiefly Brazilian and largely rain forest types, although one section of the genus has become specialized for the dry steppe-like country of the plateau of eastern Brazil.

Order SAPINDALES.

Family ANACARDIACEAE.

Genus TAPIRIRA Aublet.

TAPIRIRA LANCEOLATA Engelhardt.

Plate 15, fig. 1.

Tapirira lanceolata Engelhardt, Abh. Senck. Naturf. Gesell., vol. 19, p. 15, pl. 9, fig. 4, 1895.

Description.—Leaflets apparently sessile, broadly lanceolate and somewhat inequilateral in outline, with an acuminate tip and a rounded or cuneate base. Length about 10 cm. Maximum width, midway between the apex and the base, ranging from 2.5 cm. to 3 cm. Margins entire. Texture subcoriaceous. Midrib stout and prominent, slightly curved proximad. Secondaries numerous, somewhat irregularly spaced, subparallel and camptodrome; angles of divergence, 50 to 60 degrees. Tertiaries thin, mostly immersed.

Material that is identical with that described by Engelhardt from the interandean basin of Loja, in Ecuador, is contained in the collection from the Peruvian coast south of Tumbez. The genus *Tapirira*, as restricted in Engler's revision of the Anacardiaceae,[1] contains 5 or 6 species of shrubs or trees with odd-pinnate leaves. They are confined to tropical South America and are chiefly Brazilian. Engelhardt has compared the fossil with the existing Pao pombo, *Tapirira guanensis* Aublet, which is widely distributed in the South American Tropics, and which has leaflets that are practically indistinguishable from those of the fossil. No other fossil representative of the genus is known.

Pleseotype.—Cat. No. 35331, U.S.N.M.

Order THYMELEALES.

Family LAURACEAE.

Genus MESPILODAPHNE Nees.

MESILODAPHNE TUMBEZENSIS, new species.

Plate 15, fig. 3.

Description.—Leaves of relatively small size, broadly lanceolate and somewhat falcate in outline, with an acuminate apex and base.

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[1] Natürlichen Pflanzenfamilien, Teil 3, Abt. 5, pp. 138–178, 1896.

Length about 9 cm. Maximum width, slightly above the middle, 2.2 cm. Margins entire. Texture subcoriaceous. Petiole missing. Midrib stout, curved, prominent. Secondaries stout, but not prominent; about six opposite to alternate, irregularly and mostly widely spaced camptodrome pairs. Tertiaries mostly obsolete.

This species is based upon a small amount of material of a lauraceous leaf, apparently referable to *Mespilodaphne* and much like the leaves of a number of existing species in this genus—as, for example, the Brazilian species *Mespilodaphne brasiliensis* and *M. glauca.* These are much like the fossil, the first being relatively narrower and the second slightly wider. There are a considerable number of fossil forms that are of this type—as, for example, *Mespilodaphne pseudoglauca* Berry and *M. ooushatta* Berry from the lower Eocene of southeastern North America, although such comparisons are of but slight value beyond corroborating the generic identity.

The present species is extremely close to, if not identical with, a form from the Navidad beds of Chile described by Engelhardt[1] as *Hoffmannia protogaea.* This genus of the Rubiaceae has about a score of existing species of herbs and shrubs that are chiefly Central American in range. Although there are minor differences in venation between this Engelhardt species and the present one from Peru, I am inclined to consider the two as identical, particularly as variants described from Chile under other names serve to render this comparison still more probable.

The existing species of *Mespilodaphne*, often included with *Oreodaphne* and *Strychnodaphne* in the composite genus *Ocotea*, are confined to Africa and tropical South America, attaining their maximum development in northern South America.

Holotype.—Cat. No. 35334, U.S.N.M.

Genus PERSEA Gaertner.

PERSEA MACROPHYLLOIDES Engelhardt (?)

Persea macrophylloides ENGELHARDT, Abh. Senck. Naturf. Gesel., vol. 16, p. 650, pl. 5, fig. 3, 1891; vol. 19, p. 27, pl. 5, fig. 3, 1895.

Material from near Tumbez, too poor for figuring, strongly suggests this species which Engelhardt has recorded from both the Navidad beds of Chile and from Santa Ana in Colombia. It appears to be correctly referred to *Persea* and is especially interesting in its bearing on the correlation of these remote Tertiary outcrops.

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[1] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 16, p. 657, pl. 5, fig. 1, 1891.

Order EBENALES.

Family STYRACACEAE.

Genus STYRAX Linnaeus.

STYRAX LANCEOLATA Engelhardt (?)

Plate 15, fig. 2.

Styrax lancelata ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 32, pl. 5, fig. 9, 1895.

This species was based upon rather complete material of relatively small ovate-lanceolate coriaceous leaves from Santa Ana in Colombia. The Peruvian material is fairly satisfactory, but not positively identified.

The genus *Styrax* comprises about three score species of shrubs and trees, with two centers of distribution—northern South America (Amazon basin), extending northward through Central America and the Antilles and reappearing in the southern United States, and a second extending from China and Japan through the East Indies, with a few species extending westward to the Mediterranean region of Europe, apparently relica of a Tertiary cosmopolitanism.

About 16 fossil species have been recorded, some of which are of uncertain botanical affinity; others representing flowers and fruit as well as foliage are more convincing. Two species are recorded from the early Eocene of Colorado. There are three species in the Oligocene and eight in the Miocene of Europe, and characteristic seeds have been found in the late Pliocene of Holland. Still existing species occur in the Pleistocene of Japan. South America, in addition to the present species, has furnished two species from beds of approximately the same age in Chile.

Plesiotype.—Cat. No. 35336, U.S.N.M.

Order RUBIALES.

Family RUBIACEAE.

Genus CONDAMINEA De Candolle.

CONDAMINEA GRANDIFOLIA Engelhardt.

Plate 17.

Condaminea grandifolia ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 34, pl. 7, fig. 2; pl. 9, fig. 1, 1895.

Description.—Leaves of large size, elliptical in general outline, but with an acuminate apex. Length about 24 cm. or 25 cm. Maximum width, midway between the apex and the base, about 12 cm. Margins entire, evenly rounded. Texture coriaceous. Petiole missing. Midrib stout, prominent. Secondaries stout, but not especially so for such large leaves; there are about 12 subopposite to alternate pairs, approximately subparallel and regularly spaced; they diverge from the midrib at wide angles, becoming more ascending toward the apex of the leaf, curve regularly upward and are camptodrome. The Tertiary venation is fine but exceedingly well marked, and consists primarily of closely spaced and approximately straight percurrent nervilles.

This species is exceedingly common in the collections from near Tumbez, but because of the large size of the leaves they are usually much broken, particularly the ends and margins. One of the most perfect specimens is that shown in reduced size on plate 4. The Peru material is much more abundant and complete than the type material described by Engelhardt from Santa Ana, on the western margin of the Rio Magdalena Valley in the Colombian Andes. The general form and especially the venation are very characteristic, and there can be no doubt but that the present material is identical with that from Colombia. Regarding its botanical relationship, its reference to the genus *Condaminea* is uncertain, nor are specimens of the latter available for comparison. It suggests to me an entire leafed species of *Artocarpus*.

Engelhardt, who compared it with recent material in the German herbaria, is confident that it is a *Condaminea*, and writes that it is most similar to *Condaminea corymbosa* (Ruiz and Pavon) De Candolle, a tall shrub of the Colombian and Peruvian Andes, a reduced form of which is hardy at considerable elevations. The genus is a small one in the existing flora and comprises tall shrubs and small trees with corriaceous leaves, confined to the tropical Andean region, and not otherwise known in the fossil state.

Plesiotype.—Cat. No. 35332, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 14.

FIG. 1. *Iriartites tumbezensis*, new genus and new species, fragment two-thirds natural size.
2. Same enlarged to show details of venation.

PLATE 15.

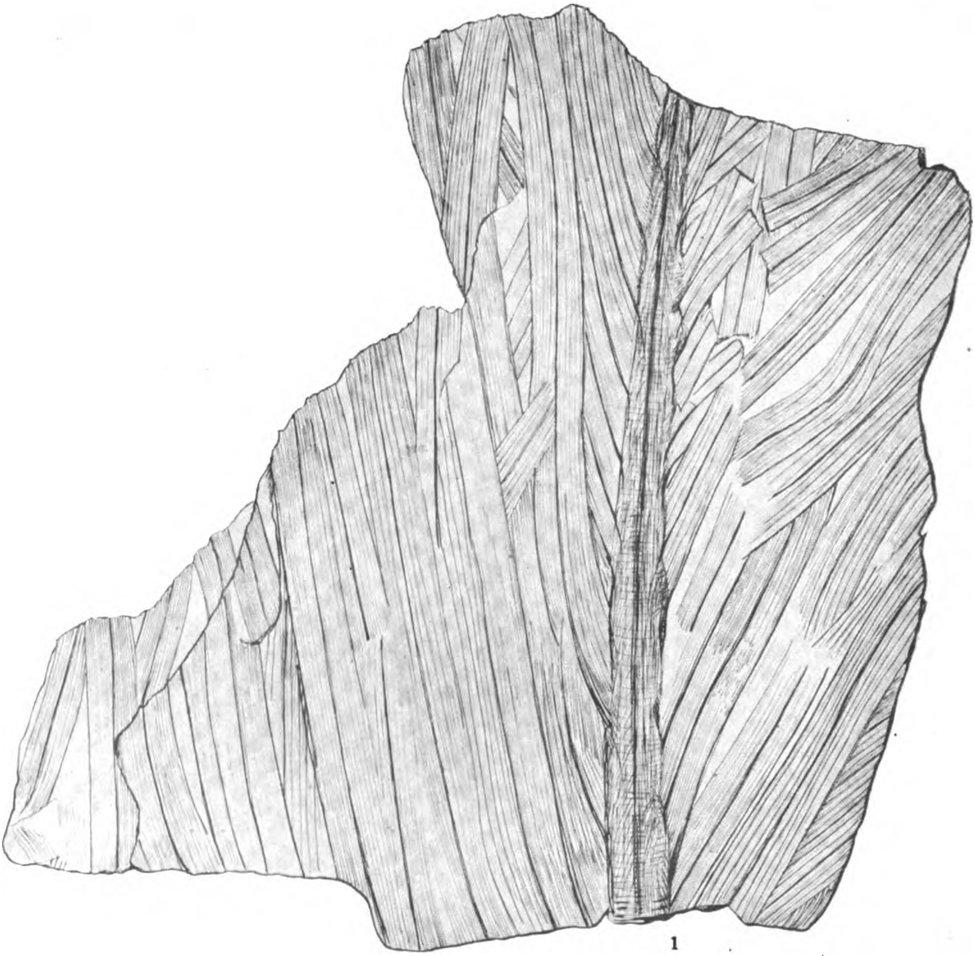
FIG. 1. *Tapirira lanceolata* Engelhardt.
2. *Styrax lanceolata* Engelhardt (?).
3. *Mespilodaphne tumbezensis* Berry.
4. *Anona winslowiana* Berry.

PLATE 16.

FIG. 1. *Banisteria incerta* Berry.
2. *Ficus winslowiana* Berry.
3. *Guatteria culebrensis* Berry.

PLATE 17.

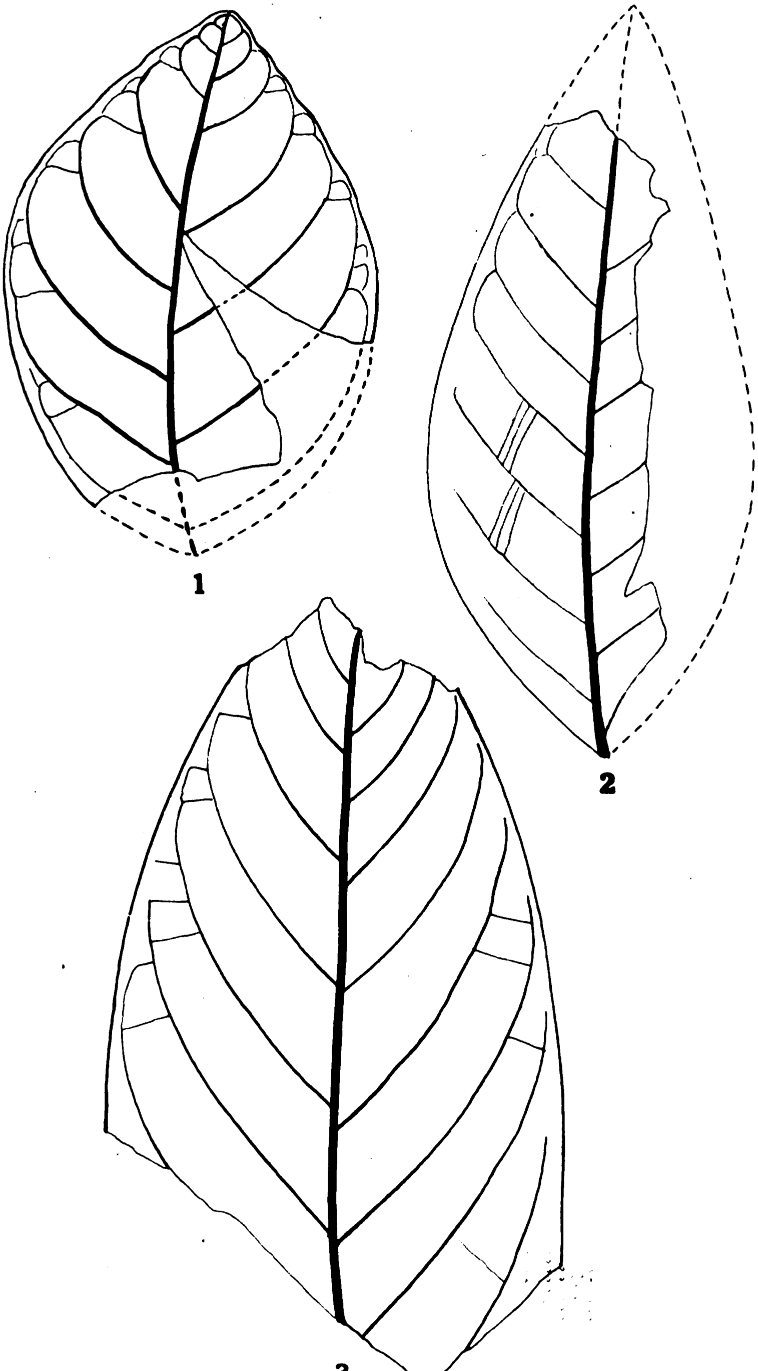
FIG. 1. *Condaminea grandifolia* Engelhardt, three-fourths natural size.


1

2

MIOCENE FOSSIL PLANTS FROM NORTHERN PERU.

FOR EXPLANATION OF PLATE SEE PAGE 294.



Miocene Fossil Plants from Northern Peru.

For explanation of plate see page 294.

FIVE NEW SPECIES OF PTINID BEETLES.

By W. S. Fisher.

Of the Bureau of Entomology, United States Department of Agriculture.

In arranging the collection of Ptinidae of the United States National Museum and the Branch of Forest Insects, Bureau of Entomology, a few apparently new species were encountered. As most of these were reared in connection with the work on insects infesting forest trees, they are here described in order to have the names available for use in economic papers.

This paper is a contribution from the Branch of Forest Insects of the Bureau of Entomology, United States Department of Agriculture.

The types of all the new species are in the United States National Museum.

PITNUS HUESANUS, new species. (Schwarz MS.)

Black, head and prothorax alutaceous, dull; elytra shining. Front narrow, distance between the antennal foveae about equal to the width of the first antennal joint; occiput with a shallow longitudinal groove. Eyes small, truncate beneath and situated close to the base of the antennae. Prothorax slightly longer than wide, sides parallel and broadly arcuate, with a median transverse constriction, which is better defined at the sides; surface rather coarsely but not closely punctured and with scattered short, pale, recumbent hairs. Elytra oblong-elliptical, twice as wide as the prothorax and scarcely more than two times as long, punctate-striate, the punctures coarse and closely placed, and each bearing at its anterior margin a short, stout, recumbent hair, which lies across the puncture; interspaces not as wide as the strial punctures, with a series of short, stout, white hairs, which are more erect than those of the striae. Surface beneath sparsely punctured, feebly shining and sparsely clothed with fine recumbent white hairs, which are more numerous on last abdominal segment. Length, 1 mm.

Habitat.—Key West, Florida. Described from three specimens collected during February and March by Mr. E. A. Schwarz on *Icthyomethia piscipula.*

Type.—Cat. No. 21428, U.S.N.M.

This species resembles *Pitnus pygmaeus* Gorham very closely in form and color, but can be distinguished from that species at once by the elytra intervals having a series of white hairs, while in *pygmaeus* they are entirely glabrous. The specimens have been in the collection under the above manuscript name, which has been retained for them.

OLIGOMERUS ARBUTI, new species.

Slender, subcylindrical, brown. Head rather strongly deflexed. Eyes round, moderate in size. Antennae 11-jointed; joint 1 large, about twice as wide and three times as long as 2; joints 2 and 3 subequal, longer than wide, the second wider than third and more oval; joints 4 to 8 subequal, slightly wider than long; joints 9 to 11 subequal, the ninth about equal in length to the three preceding, triangular, slightly longer than wide, the eleventh oblong, and two and one-half times as long as wide. Prothorax with side margins entire, narrowly margined, edge not serrate; front angles distinct, rounded; posterior angles very broadly rounded and not well defined; disk evenly rounded, not gibbose; surface finely granulate and sparsely clothed with short, prostrate reddish-brown pubescence. Elytra equal in width to the prothorax, one and three-fourth times as long as wide, feebly striate, the striae not noticeably punctured, but are interrupted by the granulation which causes them to have the appearance of a series of long dashes; surface finely thickly granulate and sparcely clothed with fine, prostrate reddish-brown pubescence. Front coxae contiguous. Middle coxae narrowly but evidently separated, the mesosternum acute posteriorly and reaching to the middle of the coxae. First joint of posterior tarsi equal in length to the three following joints united; third and fourth joints emarginate at tip. Length, 3 to 3.5 mm.; width, 1.5 mm.

Habitat.—Placerville, California. Described from three specimens recorded under Bureau of Entomology Number Hopk. U. S. 11719*b*, collected February 16, 1914, by Mr. J. J. Sullivan on dead Manzanita (*Arbutus*, species).

Type.—Cat. No. 21427, U.S.N.M.

This species differs from all other North American species, except *obtusus* LeConte, by having 11-jointed antennae, and from which it is easily distinguished by not having the prothorax gibbous and the elytral striae less coarsely punctured.

ERNOBIUS CONICOLA, new species.

Rather robust, uniform brown in color in both sexes, shining, clothed with rather long conspicuous, recumbent yellow pubescence. Head granulate-punctate; eyes large, the width of the front between them not more than one and three-fourths times their vertical diameter in the male, and about twice their vertical diameter in the female. Antennae 11-jointed, nearly as long as the body in the male, and somewhat shorter in the female; all joints longer than wide except the second, which is about as wide as long; in the male joints 3 and 4 nearly equal and only slighter longer than 2; 5 and 6 subequal, nearly twice as long as the fourth; 7 and 8 subequal, about one and one-half times as long as 6, the eighth fully three times as long as wide and about three-fourths the length of the ninth; the ninth distinctly shorter than the seventh and eighth united and fully five times as long as wide; ninth and tenth subequal; eleventh a little longer than tenth. In the female joints 3 and 4 subequal, about twice as long as wide; 5 to 8 subequal, three times as long as wide; 9 to 11 subequal, the ninth distinctly shorter than the seventh and eighth united. Prothorax as wide as the elytra, strongly transverse; sides rather strongly arcuate and broadly margined, front angles rounded, hind angles not defined; surface quite densely granulate-punctate, disk with a moderately deep impression on each side of the middle, about equal distance from median line and lateral margin. Elytra parallel, about twice as long as wide, punctuation nearly as dense but slightly finer than that of the prothorax. Metasternum and abdomen finely and densely punctured. Prosternum short before the coxae. Middle coxae separated. Basal joint of tarsi subequal in length to the next two united. Sixth ventral strongly rounded and not at all emarginate at apex. Length 5.5 to 6 mm.

Habitat.—Pacific Grove (type), and Point Lobos, California. Described from 19 specimens recorded under Bureau of Entomology number Hopk. U. S. 12579*b*, collected October 5, 1914, by Mr. J. M. Miller and reared from cones of *Cupressus macrocarpa;* and under Hopk. U. S. 13264*e*, material collected by Mr. Miller August 14, 1915, and reared from larvae feeding on scales and tissues of green and dry cones of *Cupressus macrocarpa.*

Type.—Cat. No. 21426, U.S.N.M.

This species resembles *Ernobius punctulatus* LeConte, but is easily distinguished from that species as well as any other known species in our fauna by the ninth joint of the antennae being distinctly shorter than the two preceding joints united in both sexes. The pubescence is also denser and more golden than in that species.

ERNOBIUS CALIFORNICUS, new species.

Rather elongate, uniform brown in both sexes, shining, clothed with moderately long, recumbent yellow pubescence, not nearly so long and dense as in *conicola.* Head granulate-punctuate; eyes moderately large, the width of the front between them about two times their vertical diameter in the male, and about two and one-half times their vertical diameter in the female. Antennae 11-jointed, half the length of the body in the male, a little shorter in the female; in the male joints 2, 6, and 7 subequal, nearly twice as long as wide;

3 to 5 subequal and a little longer than the seventh; 8 about as wide as long; 9 to 11 subequal, about six times as long as wide, the ninth subequal to the five or six preceding united. In the female joints 2 to 8 about subequal, the eighth slightly shorter than the others; 9 to 11 subequal, the ninth as long as the three preceding united. Prothorax as wide as the elytra and distinctly twice as wide as long; sides strongly arcuate and broadly margined, front angles rounded, hind angles not defined; surface densely granulate-punctate in the male, not quite as densely in the female, distinctly transversely impressed across the middle of disk in the female, and with only shallow depressions on each side of the median line in the male. Elytra parallel, about twice as long as wide, punctuation slightly finer than that of the prothorax, except near the base. Metasternum and abdomen finely and densely punctured. Prosternum short before the coxae. Middle coxae contiguous. Basal joint of tarsi subequal in length to the next two united. Sixth ventral deeply cleft in the male, and in the female with a deep, broadly rounded emargination at apex. Length, 4 to 5 mm.

Habitat.—Mutau Creek, Ventura County, California. Described from 16 specimens recorded under Bureau of Entomology number Hopk. U. S. 2778, collected June 4, 1904, by Dr. A. D. Hopkins, and reared from bark and outer wood of branches of recently killed *Pinus jeffreyi.*

Type.—Cat. No. 21425, U.S.N.M.

This species resembles *E. fissuratus* Fall and *E. montanus* Fall, but seems clearly distinct. From the former it differs in having a distinctly wider prothorax and the sixth ventral segment more broadly emarginate in the female; from *montanus* it may be separated by its granulate-punctate head and prothorax, and by having the pubescence longer and sparser.

ERNOBIUS CHAMPLAINI, new species.

Very elongate, black in both sexes, the tibiae and tarsi paler, pubescence short and sparse and of a cinereous color. Head across the eyes equal in width to the basal portion of the prothorax; surface finely, densely granulate-punctate; the eyes only moderately large, the width of the front between them about two times their vertical diameter in the male and about three times their vertical diameter in the female. Antennae 10-jointed, about one-half the length of the body in the male, somewhat shorter in the female; in the male joint 2 oval, distinctly wider than 3; 3 to 5 subequal, about two times as long as wide; 6 and 7 subequal, about as wide as long; 8 to 10 nearly subequal, about six times as long as wide, the eighth as long as all the preceding joints united. In the female joint 2 oval, only a little wider than 3; 3 to 7 about subequal in length, the seventh slightly shorter than the rest; 8 to 10 subequal, about three times as long as wide, the eighth about as long as the four preceding united. Prothorax narrower than the elytra, trapezoidal in form; the sides not margined, nearly straight and converging a little anteriorly, hind angles sharply defined, front angles scarcely defined; surface rather densely punctured but not distinctly granulate, with a well-defined transverse median impression. Elytra about twice as long as wide, distinctly wider at the posterior third, punctures rather fine and dense. Prosternum rather long before the coxae. Middle coxae contiguous. Legs very slender, first tarsal joint subequal to the next three united. Sixth ventral segment rounded at apex in both sexes. Length, 4 to 4.5 mm.

Habitat.—Waldo Canyon, Colorado. Elevation, 8,200 feet. Described from five specimens, two males and three females, recorded under Bureau of Entomology number Hopk. U. S. 10061*b*, collected December 31, 1914, by Mr. A. B. Champlain and reared from dead limbs of *Pinus flexilis*.

Type.—Cat. No. 21424, U.S.N.M.

This species is very closely allied to *E. trapezoideus* Fall, but is distinguished from that species by being entirely black, with the exception of the tibiae and tarsi in both sexes, by the head across the eyes not being wider than the prothorax, smaller eyes, and by the different arrangement of the antennal joints.

NEW LAND SHELLS FROM THE PHILIPPINE ISLANDS.

By Paul Bartsch,
Curator, Division of Marine Invertebrates, United States National Museum.

The United States National Museum has recently received a sending of land shells from Mr. Walter F. Webb, of Rochester, New York, for determination. This shipment proves to be the most remarkable consignment that has come to my attention, for, all but one, *Chloraea gmeliniana* Pfeiffer, of the eight forms represented, require naming, and the latter, I believe, has not been found since Cuming secured it at Bayombong.

The material was obtained from one of the Mr. Webb's collectors at Maquebenga (Makabenga), who writes: "I live in Maquebenga, one of the rancherias of the newly conquered wild people. My place is situated in this mountainous district about 30 miles from Dupax. If you were coming here you would walk over our muddy trail, coiled on the mountain sides, for about two days." This rancheria is located in the mountain range between the headwaters of the Cagayan and Magat Rivers, about 30 miles east of Dupax, in southern Nueva Vizcaya, Luzon. It is in the territory of the Ilongates, a tribe that has not encouraged foreign exploration or collecting, hence the many novelties.

The sending might be considered a sample box on account of the limited number of specimens it contained, but notwithstanding this, Mr. Webb, with characteristic generosity, has donated all the types, in most cases the only specimens received, to the United States National Museum.

The nearest relatives of the forms described below appear to be in the Mount Polis Range, which separates Nueva Vizcaya from the mountain Province in the north.

COCHLOSTYLA LIGNARIA AGUINALDOI, new subspecies.

Plate 18, fig. 4.

Shell broadly ovate, all the whorls inflated and rounded, marked by decidedly retractively slanting lines of growth and very fine, rather closely spaced spiral lirations. Suture strongly constricted. Surface covered by a thick periostracum, which carries the color markings. The color of the shell gradually changes from buff of the first turn to a dark brown, which is almost purplish-black on the last turn, while the periostracum is banded with dark zones of the same tint as the shell and light buff hydrophanous lines and bands, the width and spacing of which are shown by our photograph of the type. Aperture large; outer lip moderately reflected, marked by the spiral bands to the very edge on the outside, while within it is edged by a broad, almost black border, which changes to a purplish tinge where it joins the bluish, satiny luster that colors the rest of the interior; columella somewhat flexuose, very dark excepting at the insertion, which is white, the juncture of the white and dark areas being marked by a purple line; parietal wall covered by a moderately thick callus.

The type (Cat. No 218400, U.S.N.M.) comes from Makabenga. It has 5.9 whorls and measures—altitude, 74.8 mm.; greater diameter, 57.9 mm.; lesser diameter, 49 mm. Compared with the other known subspecies of *Cochlostyla lignaria*, the present form stands out markedly by the almost black coloration of the last whorl.

COCHLOSTYLA MACROSTOMA VIZCAYANA, new subspecies.

Plate 18, fig. 6.

Shell ovate, whorls well rounded, marked by decidedly, retractively slanting lines of growth and numerous fine incised spiral lines. Entire surface of the shell covered by a very thin deciduous periostracum, which carries the light hydrophanous spiral color markings shown in our figure of the type. The darker bands and lines are simply ground color showing through the transparent areas of the periostracum. Periphery inflated, well rounded. Suture moderately constricted. Aperture large, slightly channeled anteriorly; outer lip moderately reflected, with a broad dark brown zone at the inner edge, which shades to purplish where it joins the satiny bluish color of the interior; columella short, twisted, colored like the inner edge of the lip, at its inner border shading to the bluish of the interior on the callus that is reflected over the base; parietal wall covered by a very thin, pale bluish callus.

The type (Cat. No. 218403, U.S.N.M.) comes from Makabenga. It has 6.4 whorls and measures—altitude, 60.9 mm.; greater diameter, 40.7; lesser diameter, 33.9. The present subspecies, like all the other dark-colored *Cochlostylas* in this region, is at once differentiated from all its nearest allies by its much darker coloration.

COCHLOSTYLA CARINATA LUNAI, new subspecies.

Plate 18, fig. 5.

Shell elongate conic, decidedly carinated at the periphery of the last turn. Whorls moderately rounded, marked by slender, retractive lines of growth and rather coarse incised spiral lines. In addition to this sculpture a number of ill-defined and irregularly spaced spiral lirations are present, of which seven appear on the last whorl of the type, between the summit and the periphery. The ground color of the shell varies from livid brown on the early turns to horn color on the last. The surface is covered by a thin, deciduous periostracum, which carries the characteristic color pattern of irregular, hydrophanous axial bands, alternated with darker bands of about the same width. The arrangement of these bands is well shown in our figure of the type. Periphery of the last turn strongly angulated. Base moderately long, well rounded, marked like the surface of the spire. Aperture irregularly semicircular, decidedly channeled anteriorly; outer lip moderately reflected, marked by a very dark brown, almost purplish-black border which pales to purplish where it joins the pale blue satiny color of the interior; columella slightly concave, somewhat twisted, almost vertical, its inner edge reflected as a callus over a small portion of the base. The color of this reflected portion agrees with the dark edging of the outer lip; parietal wall covered by a thin, dark colored callus, which allows the olive color of the base to shine through it.

The type (Cat. No. 218401, U.S.N.M.) comes from Makabenga. It has 7.5 whorls and measures—altitude, 73; greater diameter, 35.3 mm.; lesser diameter, 30 mm.

In determining the systematic status of the present subspecies, it has been necessary to revise the entire group of *Cochlostyla carinata*, which has brought forth a number of new forms which will be published shortly. Of all the old and new so far seen, *Cochlostyla carinata lunai* is the most broadly conic, the most strongly carinated, and has the darkest border at the aperture.

COCHLOSTYLA LUZONICA MAKABENGANA, new subspecies.

Plate 18, figs. 1–3.

Shell helicoid, whorls well rounded, marked by fine, decidedly retractively slanting incremental lines and very fine, irregularly spaced, incised spiral striations. Nepionic turns almost two and a half, flesh colored; succeeding whorls turning rapidly darker, the last blackish-brown. The surface of the post-nepionic turns is covered by a thin deciduous periostracum, which carries the characteristic axial and spiral markings shown in our figure of the type. Suture moderately impressed. Periphery of the last whorl well rounded. Aperture large, dark brown at the inner edge, paling to smoky bluish deep within; columella very oblique; it, as well as its callus, white; parietal wall covered by a rather thin, translucent callus.

The type (Cat. No. 218404, U.S.N.M.), and a paratype in Mr. Webb's collection, come from Makabenga. The type has five whorls and measures—altitude, 29.1 mm.; greater diameter, 38.3 mm.; lesser diameter, 30.5 mm. Mr. Webb's specimen has five whorls and measures—altitude, 30.6 mm.; greater diameter, 35.5 mm.; lesser diameter, 29.2 mm. The present subspecies is distinguisred from all the other forms of *Cochlostyla luzonica* by its extremely dark coloration.

COCHLOSTYLA DOMINGOI, new species.

Plate 20, figs. 1–3.

Shell subglobose, subdiaphanous, milk white, excepting the base at the insertion of the columella, which is tinged with pale olive-green, the edge of the columellar callus being marked by a narrow line of pale purple. All the whorls well rounded, marked by fine, retractively curved, incremental lines, and fine, irregularly spaced spiral lirations, the latter becoming obsolete on the last turn. In addition to the above sculpture, the surface is slightly malleated beyond the nepionic whorls, mostly so on the antepenultimate turn. Suture moderately constricted. Periphery inflated, well rounded. Base strongly rounded, marked like the spire, the malleations, however, being faint and scattered. Aperture large, very oblique, decidedly effuse at the junction of the basal and outer lip; outer lip slightly expanded and reflected; columella slender, slightly curved, very oblique; parietal wall not covered by a callus.

The type (Cat. No. 218399, U.S.N.M.), and a paratype in Mr. Webb's collection, come from Makabenga. The type has 4.6 whorls and measures—altitude, 18.9 mm.; greater diameter, 23.8 mm.; lesser diameter, 19 mm. Mr. Webb's specimen has 4.5 whorls and measures—altitude, 19 mm.; greater diameter, 23.5 mm.; lesser diameter, 19.5 mm. This little species seems quite distinct from any of the forms known from the Philippine Islands.

COCHLOSTYLA SCHADENBERGI ILONGATA, new subspecies.

Plate 19, figs. 1–3.

Shell broadly conic, with a strong peripheral keel. Nuclear whorls white, the succeeding turns pale horn colored, gradually deepening in tint as the shell increases in size. Placed upon this ground color we find a series of irregular shaped, retractively slanting axial white areas on the posterior half of the whorls, which are about as wide as the darker areas that separate them. These light areas send out slender spurs at the summit, which meet and make a narrow, wavy white line at the upper edge of the turns. The anterior termination of the light axial zones send out a slender spur on the rear side only, which almost connect with the neighboring light zones, giving this part of the shell the aspect of being marked by a slender white spiral thread. The anterior half of the dorsal surface is marked by four spiral threads, of which the second is double the width of the rest, which are subequal, and a much broader interrupted spiral zone of irregular white blotches a little posterior to the periphery. The peripheral portion itself being blackish brown, the white and dark areas join their irregular patterns without losing their color intensity. The basal ground color agrees with that of the upper surface of the last whorl. The blackish-brown peripheral border of the upper surface is also present on the lower. This is succeeded by an irregular, broad white spiral area which is followed by four spiral white threads of which the second is about one-half as wide as the other three, which are equal. Another broad white area, equaling about one-third of the width of the base, encircles the columella. The expanded portion of the peristome is blackish-brown, tinged with reddish-brown at the inner edge. The light color also spots part of the white columella and in a little more intense form tinges the basal and parietal callus. The inside is pale bluish-white with satiny luster.

All the whorls are moderately rounded on the upper surface except at the black peripheral band, where they become slightly excurved. The basal portion of the last turn is well rounded and also lightly excurved at the peripheral keel. Aperture broadly oval, oblique, outer lip expanded and thickened; columella oblique, slightly concave, reflected over the base as a thick callus, which extends weakly over the parietal wall. On both surfaces the white spirals are impressed as if inlaid. The entire surface is marked by exceedingly fine, closely spaced striations, which cross each other at right angles and the lines of growth at an angle of forty-five degrees.

The type (Cat. No. 218402, U.S.N.M.) comes from Makabenga, Nueva Vizcaya, Luzon. It has 5.2 whorls and measures—altitude, 33.2 mm.; greater diameter, 51.2 mm.; lesser diameter, 43 mm.

This race differs from *Cochlostyla schadenbergi schadenbergi* in having the lip and peripheral keel blackish-brown, instead of pale brown. There are also decided differences in the light banding of the two forms. *Cochlostyla schadenbergi schadenbergi* comes from Quiangan, in the mountain range which lies to the west of the one from which our material was derived.

CHLOREA GMELINIANA Pfeiffer.

Plate 19, figs. 4–6.

Three specimens of this extremely rare and remarkable species were in the sending received from Mr. Webb. The general coloration of the shell is a pale green on the early whorls, deepening to dark green on the last turn. A rather broad white spiral band encircles the summit of the whorls and the base immediately below the peripheral carina. The basal portion of the peripheral keel is so intensely dark green that it appears almost black. The surface of the shell is marked by decidedly retractively slanting incremental lines, and fine incised spiral striations, and rather strong, quite regularly spaced wrinkles which are placed at right angles to the lines of growth and give the surface a decidedly malleated appearance.

The three specimens yield the following measurements: Number of whorls, 4.6, 4.6, 4.4; altitude, 14, 14.1, 13.3; greater diameter, 22.5, 23, 19.7; lesser diameter, 20.3, 19.8, 17.9. The first of the three is registered as Cat. No. 218405, U.S.N.M.; the other two are in Mr. Webb's collection. They were collected at Makabenga.

LEPTOPOMA MAUBANENSE MAKABENGANA, new subspecies.

Plate 20, figs. 4-6.

Shell broadly conic, thin, semitranslucent, bluish-white. Nepionic portion of the shell smooth. Postnuclear turns well rounded, marked by decidedly retractively slanting incremental lines and numerous very fine, closely spaced, incised spiral striations, which are present both on the spire and the base. In addition to the above sculpture, four slender, obscure cords divide the space between the summit and the periphery into five subequal areas. The cords are marked at fairly regular intervals by elongate, brownish spots. Periphery of the last whorl marked by an acute compressed keel, which extends quite prominently to the edge of the outer lip. Suture but slightly impressed. Base very short, slightly concave immediately anterior to the peripheral keel, then moderately rounded, very narrowly umbilicated, without color markings. Aperture very oblique; outer and basal lips decidedly expanded and reflected; inner lip strongly curved, slightly reflected, almost covering the umbilicus; parietal wall covered by a thin callus.

The type (Cat. No. 218406, U.S.N.M.) and a paratype in Mr. Webb's collection come from Makabenga. The type has 6.2 whorls and measures—altitude, 18.8 mm.; greater diameter, 20 mm.; lesser diameter, 15.7 mm. The paratype has 6.4 whorls and measures—altitude, 19.4 mm.; greater diameter, 20.3 mm.; lesser diameter, 15.5 mm. The present subspecies differs from *Leptopoma maubanense* in being of much lighter texture, in having the peripheral keel much more pronounced and extending to the very edge of the lip, the base less rounded, and the umbilicus much narrower.

EXPLANATION OF PLATES.

PLATE 18.

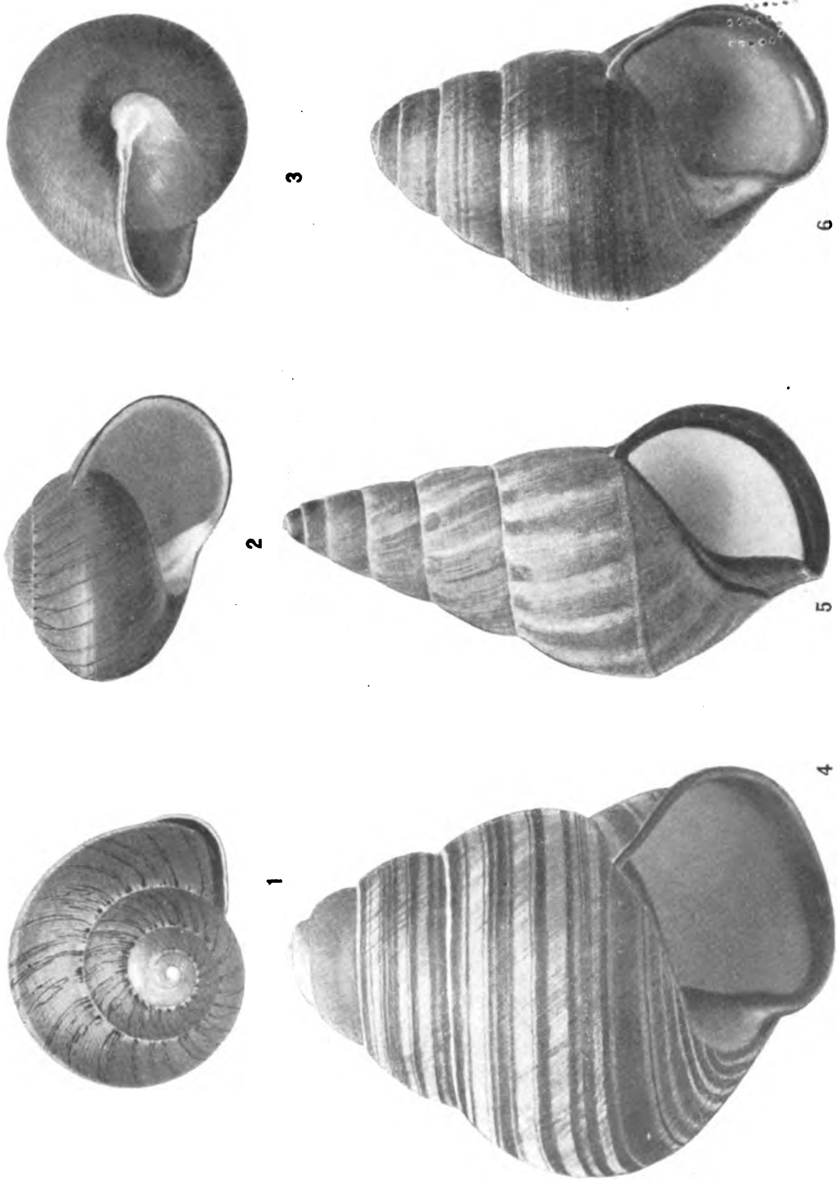
FIG. 1. *Cochlostyla luzonica makabengana*, top view, natural size.
2. *Cochlostyla luzonica makabengana*, profile view, natural size.
3. *Cochlostyla luzonica makabengana*, basal view, natural size.
4. *Cochlostyla lignaria aguinaldoi*, natural size.
5. *Cochlostyla carinata lunai*, natural size.
6. *Cochlostyla macrostoma vizcayana*, natural size.

PLATE 19.

FIG. 1. *Cochlostyla schadenbergi ilongata*, top view, natural size.
2. *Cochlostyla schadenbergi ilongata*, profile view, natural size.
3. *Cochlostyla schadenbergi ilongata*, basal view, natural size.
4. *Chloraca gmeliniana* Pfeiffer, top view, × 2.
5. *Chloraea gmcliniana* Pfeiffer, profile view, × 2.
6. *Chloruea gmeliniana* Pfeiffer, basal view × 2.

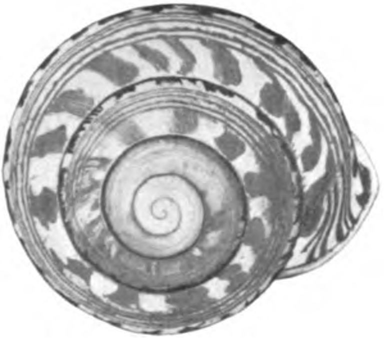
PLATE 20.

FIG. 1. *Cochlostyla domingoi*, top view, × 2.
2. *Cochlostyla domingoi*, profile view, × 2.
3. *Cochlostyla domingoi*, basal view, × 2.
4. *Leptopoma maubanense makabengana*, top view, × 2.
5. *Leptopoma maubanense makabengana*, profile view, × 2.
6. *Leptopoma maubanense makabengana*, basal view, × 2.



NEW PHILIPPINE LAND SHELLS.

FOR EXPLANATION OF PLATE SEE PAGE 308.



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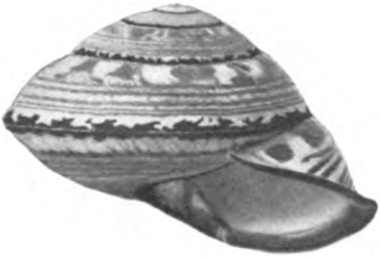

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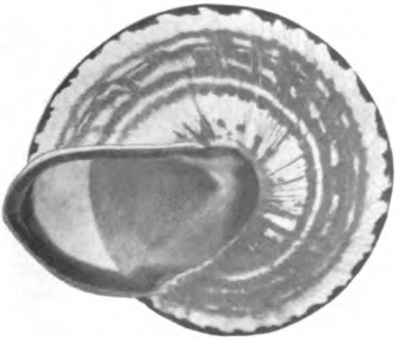

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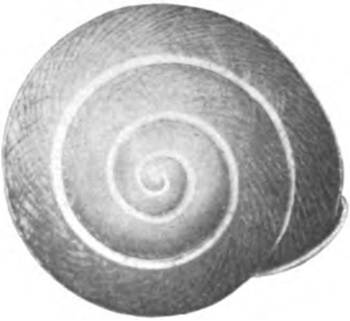

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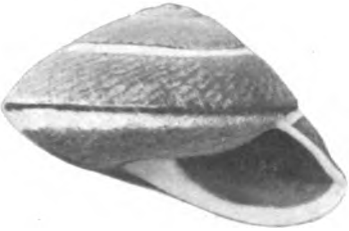

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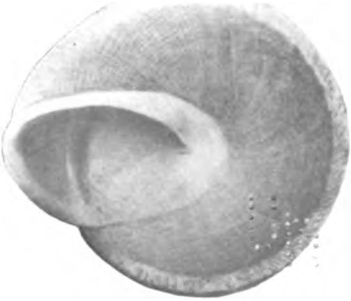

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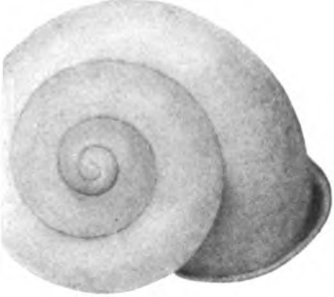
NEW PHILIPPINE LAND SHELLS.

FOR EXPLANATION OF PLATE SEE PAGE 307.



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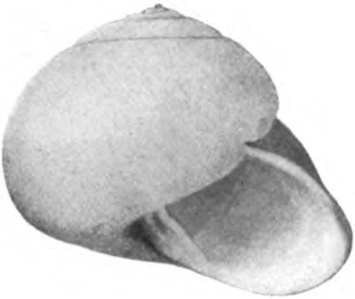

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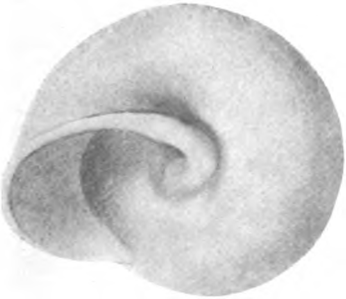

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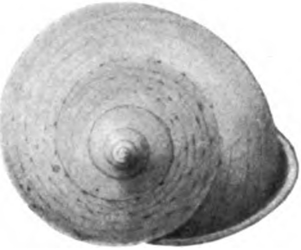

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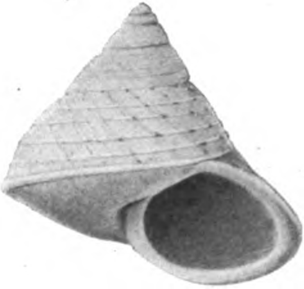

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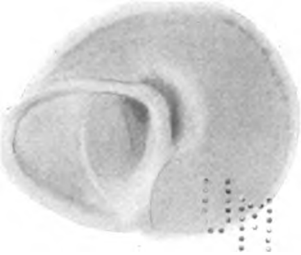

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NEW PHILIPPINE LAND SHELLS.

FOR EXPLANATION OF PLATE SEE PAGE 307.

ON CERTAIN GENERA OF ATHERINE FISHES.

By David Starr Jordan,
Of Stanford University, California.

The writer, with the cooperation of Mr. Carl L. Hubbs, has been engaged in a general review of the Atherinidæ of the world. The present paper contains preliminary notes on certain interesting forms, with figures of two American species.

Genus XENATHERINA.

Under the name of *Menidia lisa*, Dr. Seth E. Meek,[1] has described from the streams of the State of Vera Cruz, a small Atherine fish showing certain remarkable traits. It has been made the type of a distinct genus by Mr. C. Tate Regan[2] under the name *Xenatherina*.

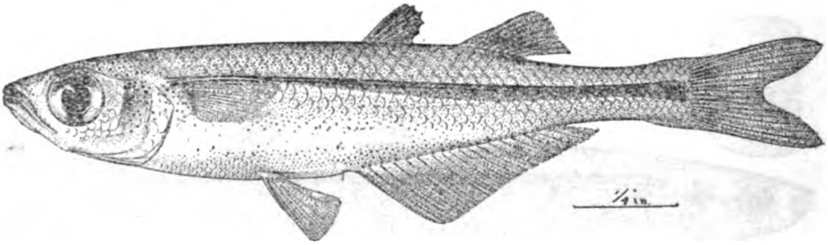

Fig. 1.—Xenatherina lisa (Meek).

With a general resemblance to the American genus *Menidia*, it differs from all other Atherine fishes by having the anterior part of the body largely scaleless. Unlike *Menidia*, however, it has the rami of the lower jaw slender and not elevated behind, agreeing in this respect with *Hepsetia*. The jaws in *Xenatherina* are very slender and long, the belly is not compressed, and the pectoral fins are short and obtuse.

The squamation of *Xenatherina* has been carefully described by Mr. Carl L. Hubbs, from whose manuscript notes I take the following:

The caudal peduncle behind the middle of the second dorsal is covered with scales of moderate size, more or less crenate, there being about twenty-five series behind the anus. From the caudal peduncle a rather wide band of scales extends forward along the middle of the sides disappearing on the trunk. Another band, narrowing anteriorly to a single series extends along the mid-dorsal line to the occiput. The belly, behind the ventral fins, is finely scaled. The remainder of the body is naked except for a few small nonimbricate scales most abundantly placed along the margin of the median scaly strip. The sides of the head are partially covered with scales which are scarcely imbricate.

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[1] Field Museum Zoology, ser. 5, p. 182, 1906.

[2] Biologia Centrali Americana, p. 64, 1906.

I here present a figure of this species, taken from one of Doctor Meek's cotypes, from a stream at Refugio, Vera Cruz. This is now in the United States National Museum (Cat. No. 82178, U.S.N.M.). It differs from the specimen above described, by Mr. Hubbs in the greater extension of the scaly area, the outer scales being imperfectly formed.

Genus HUBBESIA.

Another aberrant *Atherine* is a marine species from Panama, described by Jordan and Bollman,[1] under the name of *Menidia gilberti.* For this species I propose the generic name *Hubbesia*, in honor of Mr. Carl L. Hubbs, a former student, now curator of fishes in the Field Museum. *Hubbesia* is intermediate between *Menidia* and *Membras* Bonaparte, 1836 (based on *Atherina martinica* Cuvier and Valenciennes; apparently includes *Kirtlandia*). It has the scales somewhat rough edged, almost as in *Membras*, but without circuli, the radii conspicuously developed on the exposed field. It differs from *Membras* (*Kirtlandia*) and agrees with *Menidia* in having the first dorsal inserted before the anal, and the soft dorsal and anal free from scales. The rami of the lower jaw, as in all related genera, are notably elevated at base.

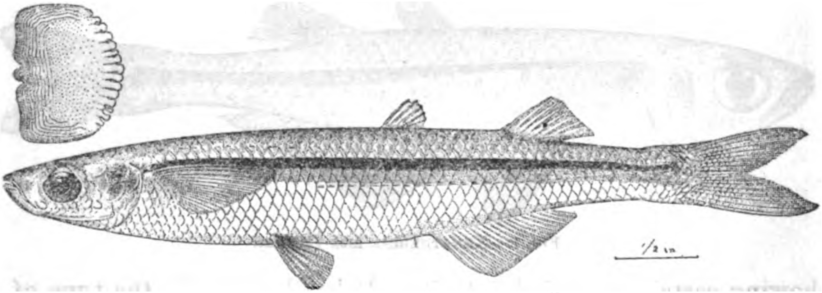

FIG. 2.—HUBBESIA GILBERTI (JORDAN AND BOLLMAN).

Genus HEPSETIA.

The character of the form of the rami of the lower jaw is an important one in this group. It was first noticed by Mr. Henry W. Fowler, who based his subgenus *Atherinomorus*[2] on a species (*Atherina laticeps* Poey) which differs from the type of *Atherina*

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[1] Proc. U. S. Nat. Mus., vol. 12, 1889, p. 155.

[2] Proc. Acad. Nat. Sci. Phila., 1908, p. 780.

(*A. hepsetus* Linnaeus) in having the rami slender, not elevated at base as usual in *Atherine* fishes.

It appears, however, that *Atherina boyeri* Risso, the type of Bonaparte's genus *Hepsetia*,[1] agrees with *Atherina laticeps* in this regard. The name *Hepsetia* must replace *Atherinomorus* and the genus is unquestionably valid.

The rami of the lower jaw are very slender behind in *Hepsetia*, *Eurystole*, *Xenatherina*, *Thyrina*, and in the Australian genus *Melanotaenia*. They are subtriangular in profile, being widened behind in all the species examined of *Protistius*, *Atherinopsis*, *Atherinops*, *Basilichthys*, *Austromenidia*, *Chirostoma*, *Menidia*, *Membras*, *Hubbesia*, *Leuresthes*, *Labidesthes*, *Thyrinops*, *Atherion*, *Atherina*, and *Atherinella*. The same form is described in *Ischnomembras* and *Phoxargyrea*.

In two genera an intermediate form appears, the rami being very slightly elevated at base. These are *Eslopsarum* and *Iso*.

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[1] Fauna Italica, 1836.

A NEW SPECIES OF PARASITIC COPEPOD, WITH NOTES ON SPECIES ALREADY DESCRIBED.

By CHARLES BRANCH WILSON,
Department of Biology, State Normal School, Westfield, Massachusetts.

Three males and two females of an undescribed species of parasitic copepod were obtained by Dr. William A. Hilton from a "swordfish" at Catalina Island, off the coast of Southern California, in 1917, which are herewith described.

GLOIOPOTES COSTATUS, new species.

Plate 21.

Host and Record of Specimens.—One male and female are still fastened together and are made the cotypes of the new species (Cat. No. 51040, U. S. N. M.); the others are free and become paratypes (Cat. No. 51041, U.S.N.M.).

Specific characters of female.—Carapace elliptical, as wide as long, squarely truncated posteriorly and not very strongly arched; frontal plates indistinct; posterior sinuses wide but shallow, the tips of the lateral lobes curved inward until they touch the sides of the third segment. The carapace is reinforced by very stout ribs; the posterior ones in the lateral area on either side sweep around backward into the lateral lobes, and are double at their base for some distance. The thoracic area is marked off in much the same pattern as in *Gloiopotes ornatus*, with the triangular eye area inserted in the center of its anterior margin. The fourth segment is about the same length and width and is covered with a pair of kidney-shaped dorsal plates, which are inclined at an angle to the body axis, with their concave sides outward. They reach quite a distance backward over the anterior end of the genital segment, leaving a wide median posterior sinus between them.

The genital segment is horseshoe-shaped, as in other species of the genus; it is contracted into a neck anteriority, then widened abruptly to half the width of the carapace and prolonged backward in a stout lobe on either side of the abdomen. The sides of the segment are convex with a smooth curve, lacking the shoulders at the anterior corners, which are found in *ornatus*. The tips of the lobes also curve inward so far that they almost meet on the midline; the dorsal surface and the lateral margins are smooth. Instead of the flap or membrane found on the lobes of this segment in *ornatus*, the present species has a conical process extending backward parallel with the abdomen and ending in three small spines, with a row of similar spines along the inner margin.

The abdomen is two-jointed and cylindrical, the basal joint the same width as the terminal but less than half as long. The terminal joint tapers uniformly backwards and is bluntly rounded posteriorly. The lateral margins are smooth, but there is a double row of spines along the center of the dorsal surface. The anal laminæ are linear, two-thirds the length of the terminal joint and tipped with small spines. The second antennae are stout, the basal joint armed posteriorly with a wide flat spine, the terminal claw strongly curved and without an accessory spine. Maxillary hooks three-parted, the two inner prongs fused and much smaller than the outer one. Maxillæ comparatively large and bifurcate, the outer ramus longer and wider than the inner one; between the rami projects a stout spine attached to the ventral surface of the head.

The furca is compound, the posterior rami bifid, the lateral ones simple; on either side of the tip of the furca is a secondary furca, attached to the head and projecting ventrally.

The first legs have three-pronged claws like those of *ornatus;* the rami of the third legs are widely separated and two-jointed. The basal joint of the exopod is armed with a large three-pronged claw, quite different from the one in *ornatus*. The fourth legs are large and stout, the basal joint longer than the three terminal ones; the latter are distinctly separated, the second and third joints with one claw, the fourth joint with three, the terminal one larger than the others. The egg strings in both females were broken.

Specific characters of male.—Carapace considerably elongated, but still quite squarely truncated posteriorly; areas and markings similar to those of the female; the posterior ribs in the lateral areas are strengthened even more than in the female, since they have two supporting ribs at their base instead of one. The dorsal plates of the fourth segment are nearly circular in outline, with a triangular sinus between their bases on the median line. While they extend laterally considerably beyond the margins of the genital segment they do not reach posteriorly as far back as in the female. The genital segment is less than half the width of the carapace, longer than wide, narrowed into a waist where it joins the fourth segment, and convex posteriorly. At each posterior corner is a wide process, flattened laterally, and extending diagonally outward and backward to about the level of the center of the abdomen. These processes taper gradually and are tipped with two small spines. The abdomen is two-jointed and relatively the same as in the female.

Of the mouth parts the maxillary hooks are somewhat smaller and shorter than those of the female; the maxillae are also smaller and the endopod is reduced so much as to be scarcely discernible. The furca is of the same general pattern, but the lateral branches are more slender and are directed diagonally backwards instead of standing out at right angles.

The swimming legs are similar to those of the female, except that the claws on the fourth pair are slightly enlarged.

Color (preserved material) a dark purplish red, deepened along the ribs and in the appendages.

Total length—female, 12.50 mm.; male, 10.50 mm. Length of carapace—female, 5.85 mm.; male, 4.66. Width of carapace—female, 5.50 mm.; male, 4 mm. Width of genital segment—female, 3 mm.; male, 1.95 mm.

(*costatus*, ribbed, alluding to the supporting ribs of the carapace.)

Remarks.—The male here described corresponds closely with the one presented by Stebbing[1] and is not at all like the one figured and described by Thomson.[2] This renders it even more probable that Thomson's specimens were both females—one with and the other without egg strings. The present species differs from *ornatus* in the dimensions of the carapace, in the size and shape of the dorsal plates on the fourth segment, in the length of the posterior lobes of the geital segment compared with the abdomen, and in the relative size of the latter.

SPECILLIGUS *versus* NESIPPUS.

In the Proceedings of the United States National Museum (vol. 33, p. 434), a parasitic copepod described by Dana under the name *Specilligus curticaudis* was referred to the genus *Nesippus*. Dana's description was published in 1852, while the genus *Nesippus* was not founded until 1865 by Heller. Apparently Heller's genus should be made a synonym of Dana's instead of the reverse, and some writers have already done this, supposedly believing that the two had been proved to be identical. Such a proceeding did not seem wise at the time above referred to, and seems even less so to-day, for the following reasons:

Dana's genus was founded upon one or two specimens, all of the male sex and unfortunately long since lost. His establishment of a new genus upon male specimens alone was not valid, because they properly belonged in the genus *Nogaus* as it then stood. There was no reason for separating them as a distinct genus, and such a reason could only be found in the structure of the females. But Dana possessed no female specimens and none have since been discovered, so that the genus still remains incapable of being justified. All the other genera in the Pandarinae are distinguished chiefly by the characters of the female, and the male plays an insignificant part in genus differentiation. And even Dana's type males are lost, so that they can never be identified with certainty.

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[1] Willey's Zoological Results, pt. 5, 1900, p. 671, pl. 74, fig. A.

[2] Trans. New Zealand., vol. 22, 1889, p. 354, pl. 29, fig. 1*a*.

If Dana's genus is restored, therefore, we have a genus not yet proved to be genuine, founded on the wrong sex, with the types lost, and which can never advance beyond a probability until the other sex is discovered.

On the other hand, Heller's genus was founded upon two species, the original female specimens of which are still preserved in the Vienna Museum, and to them have since been added the males. Accordingly, while it may not be allowable to make Dana's genus a synonym of Heller's, it certainly seems wise to retain Heller's genus, because it has been definitely proved. We can leave Dana's genus as it stands until female specimens are discovered, or until it can be conclusively established in some other way. Let us not, even in the cause of priority, sacrifice an absolute certainty for something that can never be more than a possibility.

LERNAEOPODA CLUTHAE.

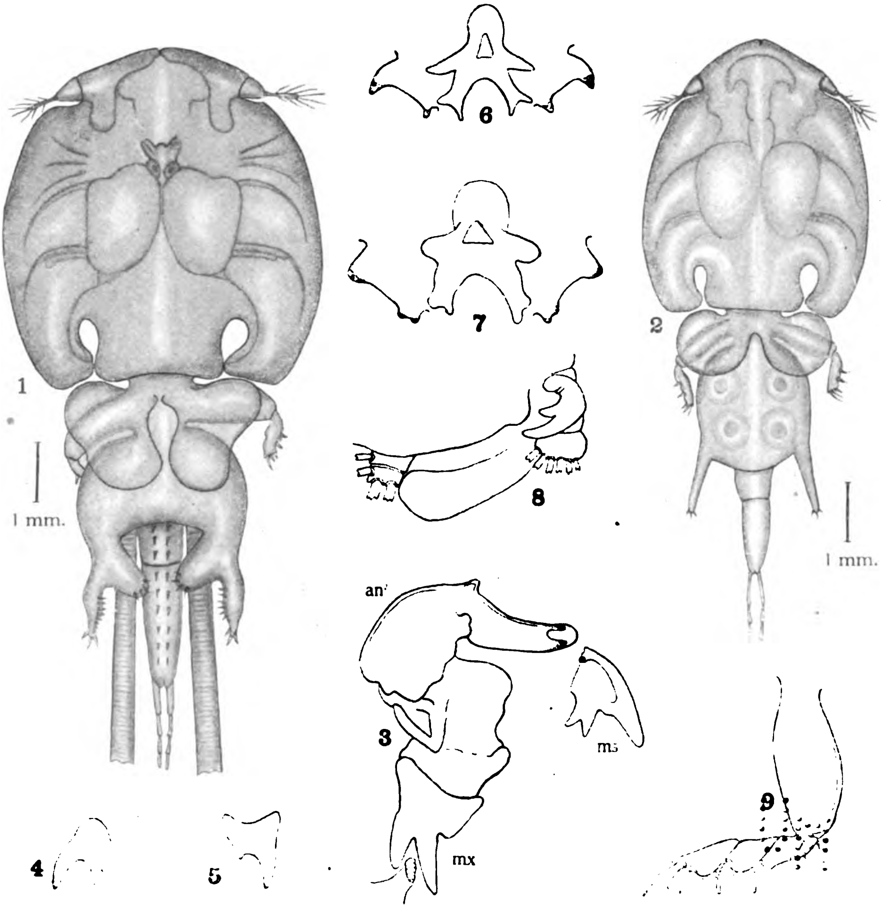
In volume 47 of these Proceedings an effort was made to locate intelligently the various species belonging to the *Lernaeopodidae*. One such species, *Lernaeopoda cluthae*, inadvertently appeared twice under different genera. The allusions to it found upon pages 653 and 654 should be eliminated, while those upon pages 639 and 640 should be retained.

LERNAEA ANOMALA.

In the Bulletin of the Bureau of Fisheries, volume 35, there is described (p. 194) and figured (pl. 14, figs. 68, 69, 70, 73, 74) a new species of parasitic copepod under the name *Lernaea anomala*. When this species was established it was placed in the genus *Lernaeocera*, as it then stood. It was afterwards found that the two genera must be transposed in accordance with the laws of priority. The specific name was all right as first established under *Lernaeocera*, but the name *Lernaea anomala* was preoccupied by Abildgaard in 1794, and although the creature he described did not belong to the genus *Lernaea*, nor even to the family Lernaeidae, it is still proper that the name be changed. Accordingly the specific name *insolens* is suggested in place of *anomala*, the two having the same meaning.

EXPLANATION OF PLATE 21.

Gloiopotes costatus, new species: Fig. 1. Dorsal view of female.—Fig. 2. Dorsal view of male.—Fig. 3. Second antenna, maxillary hook, and maxilla of female.—Fig. 4. Maxillary hook of male.—Fig. 5. Maxilla of male.—Fig. 6. Furca of male.—Fig. 7. Furca of female.—Fig. 8. Third leg of female.—Fig. 9. Fourth leg of male.



GLOIPOTES COSTATUS, A NEW PARASITIC COPEPOD.

FOR EXPLANATION OF PLATE SEE PAGE 316

DISTRIBUTION AND USE OF SLINGS IN PRE-COLUMBIAN AMERICA, WITH DESCRIPTIVE CATALOGUE OF ANCIENT PERUVIAN SLINGS IN THE UNITED STATES NATIONAL MUSEUM.

By Philip Ainsworth Means,
Collaborator in Archeology, United States National Museum.

I. THE CHARACTER OF PERUVIAN SLINGS; THEIR OCCURRENCE AND EMPLOYMENT IN PERU AND IN OTHER PARTS OF AMERICA.

Introduction.—Planned originally to be hardly more than a descriptive catalogue of a collection of slings in the United States National Museum, this paper has been gradually extended so that a more just appreciation of the importance of the sling in early Peru might be gained.

The remarkable collection upon which the study is based was made wholly by Dr. Aleš Hrdlička in the year 1913. Through his kindness and that of Dr. W. H. Holmes, head curator of anthropology in the United States National Museum, I have been enabled to study the collection and write this paper. Miss Sarah G. Flint, of the Museum of Fine Arts, Boston, has been so good as to help me with some of the technicalities of the weaving in some of these specimens, and Dr. Walter Hough, of the United States National Museum, has done likewise. I wish to express my thanks to all of them.

The distribution of the sling in ancient America.—Concerning the sling in North America, north of the Rio Grande, Doctor Hough says there is no absolute proof that the sling was known in that part of the continent before the coming of the white men, although it became more or less common after that event. It has, however, been assumed that the clay pellets found in some of the California sites were sling missiles.[1]

Slings were among the numerous weapons for offense used by the natives in Mexico, although they do not seem to have been of the first importance there, probably because the spear-thrower (*atlatl*) was more efficacious.[2] It is interesting, for purposes of comparison, to see what the older writers on Mexico have to say about the sling. Bernal Diaz del Castillo describes a battle between the Spaniards and the Mexicans in these words:

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[1] Hough, in Bulletin 30 of the Bureau of American Ethnology, vol. 2, p. 602.

[2] Clavigero, 1883, vol. 1, p. 247. Maudslay, Introduction to Bernal Diaz, p. lvii (Hakluyt Society, 1908). Nuttall, 1891.

> Thus as we approached with our army they shot from above so many stones, javelins, and arrows that they covered the ground. * * * They had slings and plenty of stones, and they shot arrows and stones so fast that they wounded five of our soldiers and two horsemen. * * *[1]

Bancroft says that the material from which the Aztec slings were made was pita thread or other fiber, and that the stones, which were carried in a pouch suspended from the waist, were hurled with much force and accuracy.[2] In Yucatan also the sling was in use. They were made of henequen, and stones were the missiles.[3]

As we possess only the most meager information as to the weapons used in the region between Yucatan and southern Panama, it is impossible to be certain to what extent the sling was used there. They were employed in the district of Tabasco and in other parts of northern Guatemala, but they do not seem to have been the most important of the long-range weapons of the region.[4] Indeed, many of the tribes in Central America seem to have used either the bow and arrow or the blowgun with poisoned darts to a much greater extent than they did the sling. Among the Coiba or Cueva of eastern Panama, however, the sling again assumes an important place in the list of weapons.[5] The bow and arrow were lacking in that region which centers about the Gulf of Urabá (or Darien).

Beginning with the territory around Antioquia on the Cauca River, in northwestern Colombia, we begin to get more evidence of the use of slings. Of the arms used in that district Cieza de León says:

> * * * The inhabitants of these valleys are brave amongst themselves and much feared by their neighbors. The men go naked and barefooted, and merely wear a narrow band fastened to a girdle round the waist. Their arms are darts, long lances of black palm, slings, and two-handled clubs, called *Macanas*. * * *[6]

In short, slings were very important in this part of South America, their only rival among long-range arms being the bow.[7] This, however, seems to mark the southern limit of the sling as used in Central America rather than the northern limit of the sling as used in South America, for that weapon seems to have been unknown in Ecuador previous to the Inca conquest, which began about 1490, and which had the result of pushing the Peruvian culture northwards rather than that of changing the fundamental character of the pre-Inca culture of Quitu (Quito) and its dependencies.[8] Inca dominance lasted not more than 40 years or so in Ecuador, and it is possible that the sling never gained a real foothold in the country.

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[1] Diaz del Castillo, Maudslay's translation, Hakluyt Society, 1908–1916, vol. 4, pp. 305–306.

[2] Bancroft, 1883, vol. 2, p. 409.

[3] Idem, vol. 2, p. 743. Ancona, 1889, vol. 1, p. 161.

[4] Idem, vol. 1, pp. 655 and 696.

[5] Idem, vol. 1, p. 761. Joyce, 1916, pp. 97–98.

[6] Cieza de León, Markham's translation, Hakluyt Society, 1864, p. 49.

[7] Simon, 1882–1892, vol. 1, p. 113. Uribe Angel, 1885, p. 513.

[8] Gonzáles Suárez, 1890, vol. 1, p. 91. Cevallos. 1870–1878, vol. 1, p. 27.

The sling appears not to have been used at all in early days in the Amazonian and Montaña regions of South America, for the blowgun, the bow and arrows, and the javelin combined to fill the needs of the people as to long-distance weapons.[1] The use of poisoned darts was very general in these regions, just as it was in parts of Central America.

In northwestern Argentina the sling was of common occurrence from Inca times onward, and it may have been in use before the Inca clan extended its rule over that part of the continent.[2] Boman gives a picture of a sling of the ribbed type having six ribs, bound in two groups of three ribs each. This specimen is almost precisely like some of those in the collection we shall shortly examine. The Araucanians of Chile, in immediately pre-Spanish times at least, used slings and were very dextrous with them.[3] I am inclined to think that the sling was, in Argentina and in Chile, an intrusive element introduced from Peru.

Having thus briefly reviewed the position held by the sling in America as a whole, the question of its use and distribution in Peru now presents itself for consideration. In the first place, the distribution of the weapon will be traced, beginning in the north.

Zárate tells us that the arms which the people of the Isle la Puna employ in their combats "are arrows and slings. * * *"[4]

This, as far as known, is the northernmost limit of the sling on the Peruvian coast. Somewhat to the south began the domains of the Chimu, stretching down the coast as far as Pativilca, Parmunca (modern Paramonga), or Huaman (modern la Barranca).[5] No doubt this large territory was subdivided into political units conterminous with the many valleys involved, but at the time of the Inca conquest the Chimu Capac, whose seat, now known as the Grand Chimu, was near the modern Trujillo, held a sway which was not merely nominal over the northern half of the Peruvian coast. Between the indeterminate southern limits of the Chimu's dominion and Chancay there was a region, now rich in archeological remains, the old political status of which is uncertain.[6] Still more southward, the valleys from Chancay to Pachacamac were under a chief bearing the title or name of Cuismancu. Pachacamac, as well known, was a famous place of temples and pilgrimage for people from the surrounding regions.[1] To the south, in the valleys of Huarca, Chilca, Mala, and Runahuanac, the chief power was in the hands of a personage called Chuquimancu. The region around Chincha Alta and Chincha Baja was ruled by a chief, named Chincha. Garcilasso tells us that before the Inca conquest the subjects of the chief called Chincha had been very powerful; that they had come from far away and that they were warlike.[2] Finally, the districts about and between Pisco, Ica, and Nasca seem to have been closely allied, after the manner of the groups of valleys further north.[3] All these coast regions were the seat of high culture for some time, in places perhaps for several centuries, before the Inca clan in the Cuzco Valley began its extraordinary climb to imperial power. The Inca dominance over this region became definitely fixed in the reign of Pachacutec (between 1425 and 1475 A. D.), although preparatory conquests, mainly in the southern parts of the the coast country, were probably made as early as the reign of Inca Rocca (about 1350 A. D.).[4]

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[1] Whiffen, 1915, pp. 115–117.

[2] Boman, 1908, pp. 451–453 and fig. 97.

[3] Molina, 1809, vol. 2, p. 72.

[4] Zárate, 1830, vol. 1, p. 23. (Translation mine.)

[5] Markham, 1912, p. 181. Squier, 1877, p. 165. García Rosell, 1903, pp. 199–203.

[6] Idem, p. 181.

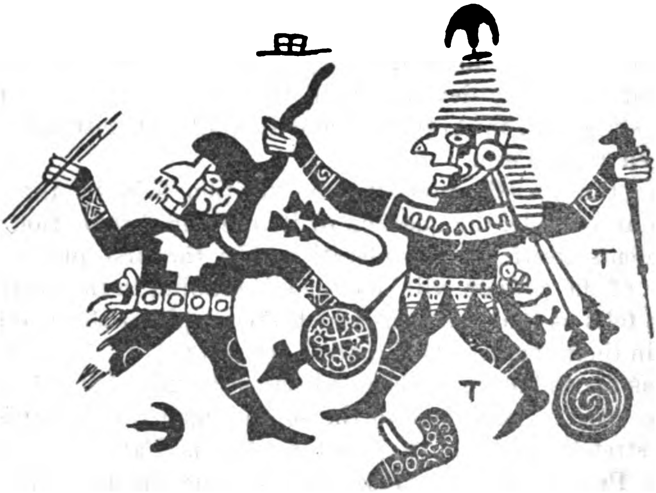

FIG. 1.—BATTLE SCENE SHOWING USE OF SLING.

Such, in brief, were the political subdivisions of the coast people of Peru. Although broken up into a number of chiefdoms, and doubtless numerous tribes, these people belonged to one general type or stock.[5] They were brachycephalic, like the people of Central America, with more or less intrustion, according to region, of the highland population.[1] The archeological evidence concerning the occurrence of the sling among these peoples, though still far from being as complete as one could desire, is full enough to permit us to form some estimate as to its distribution and character in the various parts of the littoral.

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[1] Garcilasso, Markham's translation, Hakluyt Society, 1869 and 1871, vol. 2, pp. 185–193. Markham, 1912, p. 181. Means, 1917b, p. 329. Joyce, 1912, p. 95.

[2] Idem, pp. 149–153.

[3] Idem, p. 147. Joyce, 1912, p. 95. Markham, 1912, pp. 176–178. Means, 1917, p. 289.

[4] Means, 1917, pp. 246–249.

[5] Hrdlička, 1914, p. 48.

In the Chimu region, where many realistically painted vessels have been found, vase paintings showing combats in which slings are being used occur.[2] Figures 1 and 2 show two of the most interesting battle scenes painted on pre-Inca vessels from the neighborhood of Trujillo. The slings are not depicted in detail, but they are unmistakable.

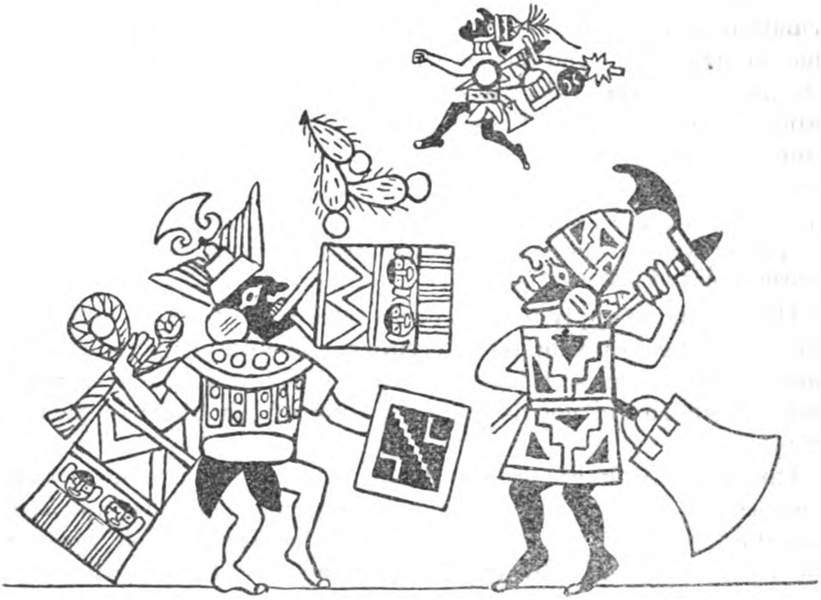

FIG. 2.—BATTLE SCENE SHOWING USE OF SLING.

Beginning at Ancon, we have actual specimens of slings, and it is interesting to note that both types of sling to be hereafter described—the solid-cradled and the ribbed—are found at that site.[3] The same is true to a still greater extent at Pachacamac. Some confusion is caused in this connection at Pachacamac and elsewhere by a custom that seems to have existed of twisting a sling about the head, making it perform the functions of a fillet. As a result of this practice some of the specimens are so ornate as to be practically useless for any purposes save those of adornment.[4] One ribbed sling from Pachacamac has 13 ribs at the middle of the cradle and seven ribs at either end, somewhat like No. 301127, from Coyungo, in the collection to be described presently. (See my plate 26, figure 3.) In the Pachacamac specimen, however, all the ribs are bound together. In both, part of each cord is flat, and there are tassels.[1] Solid-cradled slings are not wanting at Pachacamac, some of them suggesting those found at Lomas (Nos. 301048–301056).[2]

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[1] Hrdlička, 1911, pp. 9–11.

[2] See Baessler, 1902–03, pls. 36 and 37. (My figs. 1 and 2 are reproduced from them.) Hamy, 1897, pl. 41, figs. 117 and 118.

[3] Reiss and Stuebel, 1880–87, pls. 75 and 76.

[4] Uhle, 1903, pl. 19, fig. 5, is an example of this development.

In the region of Nasca the use and probably also the development of the sling has, as will be shown later on, reached its acme. Also, it was found by Dr. A. Hrdlička, its use persisted well into post-Columbian times.

From the above it is clear that the sling enjoyed a very general distribution on the coast. Nor was it lacking in the highland parts of the country. The Indians of the region of Chachapuya (modern Chachapoyas) were ruled, in immediately pre-Inca times, by a chief called Chuqui-Sota.[3] Of these people and their curious use of the sling Garcilasso says:

> * * * These Chachapuya Indians wear, as a distinguishing headdress, a sling, by which they are known from other Indians. Their sling is different from those of other tribes, and is the principal arm they use in war, like the ancient people of Majorca.[4]

These remarks apply to the Chachapuya at the time when the Inca was beginning to invade their territory. The use here, as in Pachacamac, of the sling as a head ornament is noteworthy. It is a pity that Garcilasso did not describe the sling of the Chachapuya more fully.

Through a lack of archeological evidence we have no detailed knowledge as to the sort of slings used by the Quichuas and other mountain peoples. In the later part of the Inca period, however, the weapon was used by the Inca clansmen of Cuzco. Garcilasso says:

> * * * The arms were * * * supplied by the provinces where the materials for making them were most abundant. In some they made bows and arrows; in others they made lances and darts; in others clubs and axes; in others slings and lashings; in others shields, for these shields were their only defensive weapons. * * *[5]

Further on he says, speaking of the puberty ceremonies of the youth of the Inca clan:

> * * * The novices were expected to know how to make all offensive weapons used in war, with their own hands, or at least those which did not require the blacksmith's art, such as bows and arrows, a dart thrown by

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[1] See Uhle, 1903, pl. 19, fig. 1.

[2] Uhle, 1903, pl. 19, figs. 2, 3, and 9.

[3] Sarmiento, Markham's translation, Hakluyt Society, 1907, p. 129.

[4] Garcilasso, vol. 2, p. 322.

[5] Idem, pp. 18–19.

means of a leather strap, a lance with a sharpened point, and a sling made of reed. * * *[1]

A hint as to the nature of the slings used in the mountains at the time of the Inca dominion is given by Cobo:

> * * * Of their offensive arms some are for fighting at a distance and others for hand-to-hand fighting. For fighting at a distance they used slings made of wool or of Cabuya, with which they were great sharpshooters. Almost all the people of this kingdom used them, particularly the mountaineers, who were very skillful slingers. * * *[2]

It seems not to be unlikely that the slings of which Cobo speaks were more or less like those on the coast. *Cabuya* is a kind of aloe.[3]

In the region about Lake Titicaca, also, the sling was used, and still is.[4]

Some notion as to the tactical significance of the sling is gained from a passage from Xeres, who, speaking of the capture of Atahualpa at Cajamarca by the Spaniards, says:

> * * * In this town of Caxamalca, * * * the arms they found, with which they made war, and their manner of fighting were as follows: In the van of their army came the sling-men, who hurled pebbles from slings. These sling-men carry shields, which they make from narrow boards, very small. They also wear jackets of quilted cotton. Next came men armed with sticks having large knobs at one end, and axes. The sticks are a braça and a half in length, and the thickness of a lance. The knob at the end is of metal, with five or six sharp points, each point being as thick as a man's thumb. They use them with both hands. The axes were the same size or larger. The metal blade was a palmo in width, like a halberd. Some of the axes and clubs, used by the chiefs, were of gold and silver. Behind these came men armed with hurling lances, like darts. In the rear were pikemen with lances 30 palmos in length. * * *[5]

Conclusion.—We have now seen that the sling was widely distributed over Mexico and Central America and in the northernmost parts of South America. It can not, however, be said to have been the most important offensive weapon in the greater part of this region; it is, of course, possible that it was more important before the more efficacious spear-thrower and bow attained the development they possessed at the time of the Spanish conquest. In the more southerly parts of Central America the sling has a formidable rival in the blowgun, a weapon probably derived from the people of the Amazon region. Nevertheless, the sling was of general occurrence; it may well have been the chief long-range weapon in the earlier periods. The sling is especially important in certain coastal regions of Peru in pre-Inca times, and it is also one of the chief weapons of the people in the mountains. By the Incas the sling was given a still wider distribution.

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[1] Garcilasso, vol. 2, p. 171.

[2] Cobo, 1892, vol. 4, p. 194. The translation is mine.

[3] Cieza, 1864, p. 146.

[4] Bandelier, 1910, p. 88. Beuchat, 1912, pp. 581 and 669.

[5] Xeres, Markham's translation, Hakluyt Society, 1872, p. 60.

As to the derivation of the sling in South America there is, I think, but very little doubt that it was one of the cultural elements brought from Central America by the first settlers on the Peruvian coast, and that it spread from there inland, and over large parts of the continent.

A GENERAL DESCRIPTION OF THE PERUVIAN SLING.

An examination of the Hrdlička collection together with other available specimens, reveals the presence of two distinct types of sling. The differentiation rests upon the structure of the part of the weapon upon which the missile was placed, which is called the cradle. The cradle is, of course, the most important part of the sling. In the Peruvian specimens it is usually oblong or oval in shape, and from each end depend one or two cords. In the collection under discussion the two types of cradle provide the basis for classification. One type is that which I shall call "the solid-cradled type"; that is, the cradle is one continuous compact strip of fabric. The other sort of cradle is "the ribbed type"; in it the ribs, running parallel with the length of the cradle and encased in a binding of fine threads, not only make apparent the method of its construction, but they also form an important part of the decoration of the sling. Among the four sites represented in the Hrdlička collection the two sorts of sling are thus represented:

Nasca: Four solid-cradled slings (Nos. 301001–301004, inclusive); 32 ribbed slings (Nos. 301005–301035, inclusive).

Coyungo: No solid-cradled slings; 23 ribbed slings (Nos. 301124–301143, inclusive, and Nos. 301153–301155, inclusive).

Lomas: Twenty-four solid-cradled slings (Nos. 301046–301069, inclusive); 49 ribbed slings (Nos. 301070–301118, inclusive).

Acarí: No solid-cradled slings; 9 ribbed slings (Nos. 301144–301152, inclusive).

It is seen that the two types are not universally present or equally common.

To the basis presented by the cradle and attached cords additional features are sometimes added in the form of tassels. The cord may be round or flat in cross section. The decoration of the cradle in a class of the flat slings are divided into three distinct parts.

Tassels are frequent in all the sites save Acarí (where the slings were generally poorer in quality than elsewhere), but the habit of combining the flat or partly flat cord with the tripartite subdivision of the decoration of the cradle is distinctive of Coyungo (see Nos. 301124–301135, inclusive), only one other example of it, No. 301022, from Nasca, occurring elsewhere.

Aside from the major varieties of the sling, the solid-cradled type and the ribbed type, there are in the collection several groups of slings from different sites which merit a special description. The first specimens of note from the point of view of structure are Nos. 301001 and 301002, solid-cradled slings from Nasca. There are in each of these slings two warp threads encased in a close-set continuous spiral woof, upon which, in turn, the surface threads bearing the surface decoration are woven. Doctor Hough, who examined the specimens, says that this technique is most unusual. Figure 3 on page 325 makes it clear how these slings were made.

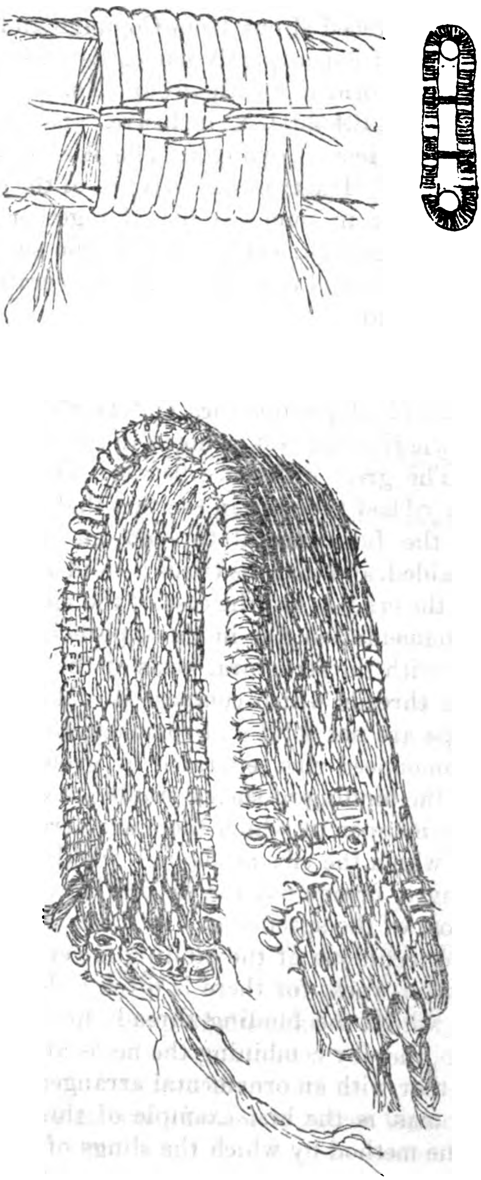

FIG. 3.—SOLID-CRADLED SLING WITH METHOD OF MAKING.

Another group of slings which is noteworthy is that distinguished by having six ribs at the center, arranged in two groups of three, but having only two ribs at the ends, the number diminishing in such a way that the grooves between the ribs themselves form a symmetrical pattern. The cradle thus formed is oval in outline, and it has a border for decorative purposes around the edge. The slings contained in this group are Nos. 301005–301013, inclusive, from Nasca, and Nos. 301137–301143, inclusive, from Coyungo.

A third group, Nos. 301048–301056, inclusive, from Lomas, has for its peculiarity the reversing of the colors from one side of the fabric to the other. The shades used are brown and white; that part of the design which is brown on one side is white on the other, and vice versa. The outline of the pattern is the same on both sides, only the colors alternating. Mr. M. D. C. Crawford has described some cloth like this under the name of "double cloth."[1] Two sets of yarn were used, but they were firmly locked together as a result of the interchange of color areas.

The ribbed slings from Coyungo and Nasca, which show a combination of flat or partly flat cords with a tripartite subdivision of the cradle, form a fourth group, No. 301022, coming from Nasca, and Nos. 301124–301135, inclusive, and Nos. 301153–301155, inclusive, coming from Coyungo. The flat part of the cords is elaborately braided. The two end divisions of the cradle have all their ribs (usually four in number) bound together with colored threads, which form a geometrical pattern on the surface; the middle division has the ribs bound in pairs, and the decoration there is less elaborate than at the ends.

The four groups just reviewed comprise the more noticeable departures from the ordinary sorts of solid-cradled and of ribbed slings. Individual peculiarities and minor points relative to the grouping of the ribs can best be noted in the detailed notes on the collection.

The great difference between the solid-cradled type of sling and the ribbed type lies in the fact that in the former the decoration rests in the fundamental threads out of which the fabric is woven or braided, and that the tissue is solid and compact throughout the length of the cradle. In the case of the ribbed slings, on the other hand, the ornamentation lies in the superficial binding, which has nothing to do with the structural basis of the fabric save in so far as it encases the threads which compose it. Moreover, the cradles of the ribbed type are not solid and compact; they are broken up lengthwise into pronounced ribs separated by grooves and interstices. The threads of the binding of such a cradle are usually of two or more colors, and the manner in which these are arranged combined with the pattern in which the ribs are bound, whether in pairs, in threes, or fours, or singly, brings out the decorative element which is so prominent in most of the specimens. In most of the specimens of the ribbed type the technique of the binding is very much like that of some sorts of basket-work, for there is often a decorative purpose in the intervals at which the binding threads have been made to step from rib to rib, thereby combining the necessary function of binding the ribs together with an ornamental arrangement of spaces. No. 301071, from Lomas, is the best example of this technique. (See pl. 25, fig. 2.) The method by which the slings of the solid-cradled type were made bears, in general, a greater resemblance to the ordinary textile technique. In some cases there is a true warp and a true woof; again, the woof is sometimes replaced by a continuous warp, which zigzags from side to side throughout the length of the fabric. Finally, braiding, of a rather elaborate nature, is common.

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[1] Crawford, 1916, p. 135.

As regards color and design these slings are admirable. Black, white, brown, yellow, and red are the commonest shades; but blue, green, buff, and pink also appear, though with less frequency. Sometimes the sling proper is without ornamentation, or its tassels are its only decoration. More often, however, the cradle and that part of the cords which is next to the cradle have a well-executed design in colors. Although geomtric designs are in the majority, the zoomorphic element makes its appearance, as in Nos. 301002, 301007, 301010, from Nasca. Doctor Hrdlička is of the opinion that the decorations of many of the strings represent a snake. All the specimens, save Nos. 301046 and 301047 from Lomas, are entirely of wool. The two exceptions specified have cotton foundations with wool embroidery. (See pl. 22, fig. 3.) The prevalence of wool is interesting as indicating a well-developed trade between the coast and the mountain regions, for the wool-bearing animals indigenous to Peru all live at high altitudes.[1] Although they are not represented in the collection under discussion, other materials were used for slings in ancient Peru. Slings made of human hair, of llama hide, and of vegetable fiber have been reported from Ancon.[2]

In point of size the slings vary widely. Their dimensions may be summarized thus:

Total length of slings:
  Maximum=28 feet (No. 301124).
  Minimum=3 feet, 3 inches (No. 301010).
  Average=8 feet, 10 inches.
Cradle:
  Length—
      Maximum=18½ inches (No. 301002).
      Minimum=3 inches (No. 301026).
      Average=7¾ inches.
  Width—
      Maximum=3½ inches (No. 301070).
      Minimum=¼ inch (Nos. 301022 and 301116).
      Average=1½ inches.

II. DESCRIPTIVE CATALOGUE OF A COLLECTION OF SLINGS FROM SOUTHERN PERU.

Specimen No. 301001.—Cradle of a sling of the solid-cradled type. Locality: Nasca.

Colors.—Red and yellow.

Design.—Three longitudinal rows of diamonds formed by yellow lines on a red ground.

Material.—Wool.

Remarks.—The structure consists of two parallel warps encased in a continuous spiral woof very closely wound about the two warp-threads. Over this foundation is woven the outer covering, which bears the surface design mentioned above. The surface threads are so compactly woven that the underlying structure is obscured by them. (See fig. 3.) Condition, fragmentary.

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[1] Scott, 1913, p. 390. Flower and Lydekker, 1891, p. 300.

[2] See Reiss and Stuebel, pl. 76, fig. 9. Specimens showing the use of these materials occur in several museum collections, notably in that of the Peabody Museum of Harvard University. A sling decorated with feathers also appears there.

Specimen No. 301002.—Cradle of a sling of the solid-cradled type. Locality: Nasca.

Colors.—Red, yellow, and dark green.

Design.—Partly zoomorphic, showing conventionalized animals (dogs or llamas). Otherwise geometric. (See pl. 23, fig. 1.)

Material.—Wool.

Remarks.—The underlying structure is the same as that in No. 301001. As the design is more elaborate here, however, the woof threads have been made to emphasize some of the horizontal lines of the design. Condition, fragmentary.

Specimen No. 301003.—Cradle of a solid-cradled sling. Locality: Nasca.

Color.—Black.

Material.—Wool.

Remarks.—There is no woof. Specimen is elaborately braided. Condition, fragmentary.

Specimen No. 301004.—Sling of the solid-cradled type. Locality: Nasca region.

Colors.—Dark brown and white.

Design.—Simple and geometric.

Material.—Wool.

Remarks.—Condition, good.

Specimen No. 301005.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, black, and yellow.

Design.—Simple and geometric. (See pl. 23, fig. 2.)

Material.—Wool.

Remarks.—Cradle has six ribs at center. The number diminishes toward the ends in such a way that the grooves between them form a symmetrical design. Parts of the cords at both ends of the cradle have a decorative binding. Condition, fragmentary.

Specimen No. 301006.—Part of a sling of the ribbed type. Locality: Nasca region.

Remarks.—A replica of No. 301005. Condition, bad..

Specimen No. 301007.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Black, red, green, and yellow.

Design.—Geometric, with highly conventionalized birds in yellow and green on a red ground. The cradle is black with a border of birds.

Material.—Wool.

Remarks.—The arrangement of the ribs is the same as that in No. 301005. Condition, fair.

Specimen No. 301008.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, and black.

Design.—Geometric.

Material.—Wool.

Remarks.—The six ribs in the cradle are arranged as in No. 301005. Condition, fragmentary.

Specimen No. 301009.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red and white.

Design.—Geometric.

Material.—Wool.

Remarks.—The six ribs are arranged as in No. 301005. A tear in the binding of one cord shows its structure. The undyed cord proper is bound at frequent intervals with three or four twists of fine undyed thread. Upon this rests the woven outer binding on which the design appears. The outer binding consists of a continuous spiral woof held together by the embroidered design on its outer side. Condition, fragmentary.

Specimen No. 301010.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, buff, and green.

Design.—Geometric, with conventionalized birds and fishes in green and yellow on a red ground. (See pl. 23, fig. 3.)

Material.—Wool.

Remarks.—The six ribs are arranged in the same way as in No. 301005. Condition, fair.

Specimen No. 301011.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, green, and white.

Design.—Geometric.

Material.—Wool.

Remarks.—Condition, bad.

Specimen No. 301012.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, buff, yellow, olive green, and black.

Design.—Geometric. (See pl. 23, fig. 4.)

Material.—Wool.

Remarks.—The cradle has six ribs at the center, the number diminishing toward the ends, as in No. 301005. The part of the cords which is next the cradle is flat in cross-section, not round. Condition, fragmentary.

Specimen No. 301013.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, and black.

Design.—Geometric.

Material.—Wool.

Remarks.—The cradle has six ribs, arranged in the same manner as in No. 301005. Condition, fair.

Specimen No. 301014.—Sling of the ribbed type. Locality: Nasca region.

Color.—Red.

Design.—Plain. (See pl. 24, fig. 1.)

Material.—Wool.

Remarks.—One of finest slings in the collection. The cradle has 15 ribs in the central portion and 8 ribs, of twice the size of the others, at both ends. Part of each cord is elaborately braided in such a way as to have a flat cross section. There were originally four fine tassels, two of which now remain. Condition, good.

Specimen No. 301015.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Black and white.
Design.—On cradle, checkerboard design; elsewhere simple and geometric.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301016.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Brown and white.
Design.—Irregular patches of the two colors.
Material.—Wool.
Remarks.—Cradle has four ribs bound in pairs. Condition, fair.

Specimen No. 301017.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Cradle, white; cords, black and white.
Material.—Wool.
Remarks.—Cradle has six ribs, bound in two groups of three. Condition, fragmentary.

Specimen No. 301018.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Black and white.
Design.—Cradle white with black border. (See pl. 24, fig. 2.)
Material.—Wool.
Remarks.—Crade has six ribs, bound in two groups of three. Condition, fragmentary.

Specimen No. 301019.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, fair.

Specimen No. 301020.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Brown and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. The cords are knotted together at the ends. Condition, good.

Specimen No. 301021.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Dark brown and light brown.
Design.—Simple and geometric.

Material.—Wool.

Remarks.—Cradle has six ribs, bound in two groups of three. The ribs are arranged as in No. 301005. Condition, poor.

Specimen No. 301022.—Sling of the ribbed type. Locality.—Nasca region.

Colors.—Dark brown, light brown, and black.

Design.—Geometric. (See pl. 24, fig. 3.)

Material.—Wool.

Remarks.—This sling is so delicate as to suggest that it was either ceremonial or for use by a young boy. The cradle has four ribs bound together for 3 inches at each end, but bound in pairs for 2¾ inches at the center. Part of the cords is braided, as in No. 301014, and flat in cross-section. Condition, fair.

Specimen No. 301023.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, white, and black.

Design.—Irregular patches of red and white on cradle; cords have concentric diamonds of the three colors; one tassel white, the other black.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. The two tassels are good. Cord attached to white tassel has three knots in it. Condition, good.

Specimen No. 301024.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Dark brown and white.

Design.—On cradle, irregular patches of the two colors. On upper parts of the cords, zig-zag rings of same colors. Condition, fragmentary. Cradle has four ribs, bound in pairs.

Material.—Wool.

Specimen No. 301025.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, brown, and white.

Design.—Simple and geometric. (See pl. 24, fig. 4.)

Material.—Wool.

Remarks.—Cradle has four ribs, bound together, like those in No. 301022. Condition, fair.

Specimen No. 301026.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, white, and black.

Design.—Geometric.

Material.—Wool.

Remarks.—Cradle has four ribs, bound together. The fineness of the specimen suggests that it was either ceremonial or for use by a young boy.

Specimen No. 301027.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, buff, green, brown, and black.

Design.—On cradle, irregular patches of all the colors. On cord, con diamonds.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301028.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Brown, black, and white.

Design.—On cradle, elaborate diamond-pattern.

Material.—Wool.

Remarks.—Cradle has 14 ribs, originally bound in 7 couples. They are now in a very bad condition.

Specimen No. 301029.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Black and white.

Design.—Simple and geometric.

Material.—Wool.

Remarks.—Cradle has four ribs bound in pairs. The one tassel which remains is black. Condition, fragmentary.

Specimen No. 301030.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, white, and black.

Design.—On cradle, elaborate diamond-pattern. On cords, snake-like pattern or rings running around cord.

Material.—Wool.

Remarks.—Cradle has 10 ribs, bound separately but locked together at intervals. The technique of the cord is interesting. It is three-quarters of an inch thick and consists of a twisted woolen cloth, undyed, overlaid with a woven cover of black and white wool. Condition, very poor.

Specimen No. 301031.—Part of a sling. Locality: Nasca region.

Remarks.—Probably the missing cord of No. 301030.

Specimen No. 301032.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, white, and black.

Design.—Black diamonds set end to end and red diamonds set end to end on a white ground. This design on cords. Cradle more simple.

Material.—Wool.

Remarks.—Cradle has seven ribs. Condition, bad.

Specimen No. 301033.—Sling of the ribbed type. Locality: Nasca region.

Colors.—Red, purple, yellow, green, black, and white.

Design.—Diamond pattern.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, very poor.

Specimen No. 301034.—Cradle of a sling of the ribbed type. Locality: Nasca region.

Colors.—Red, yellow, and dark brown.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—Six ribs, bound in two groups of three. Condition, bad.

Specimen No. 301035.—Cradle of a sling of the ribbed type. Locality: Nasca region.

Colors.—Red, white, and black.
Design.—Geometric.
Material.—Wool.
Remarks.—Six ribs, bound in two groups of three. Condition, bad.

Specimen No. 301036.—A tassel from a sling. Locality: Nasca region.

Colors.—Red, green, and white.
Design.—Conventional.
Material.—Wool.
Remarks.—Part of another sling is tied to the tassel. Condition, fragmentary.

Specimen No. 301037.—A tassel from a sling. Locality: Nasca region.

Colors.—Tassel, green. Cord, red with some purplish-brown threads.
Material.—Wool.
Remarks.—Condition, fragmentary.

Specimen No. 301038.—A tassel. Locality: Nasca region.

Colors.—Cord, white. Tassel, red, dark brown, pink, light brown, and green.
Material.—Wool.
Remarks.—The red threads which form the tassel are gathered into ten strands, which are tightly bound for nine inches of their length with fine threads, which form narrow rings of the other colors. From the point where the binding stops the threads of the tassel fall loosely. (See pl. 22, fig. 1.)

Specimen No. 301039.—A tassel. Locality: Nasca region.

Colors.—Tassel, red; cord, red, yellow, and green.
Design.—Simple and geometric design on the top part of the tassel.
Material.—Wool.

Specimen No. 301040.—A tassel. Locality: Nasca region.

Color.—Black.
Material.—Wool.
Remarks.—Condition, poor.

Specimen No. 301041.—A tassel. Locality: Nasca region.

Colors.—Tassel, green; cord, green, with buff rings at intervals.
Material.—Wool.
Remarks.—Condition, fragmentary.

Specimen No. 301042.—Part of a sling of the ribbed type. Locality: Nasca region.

Colors.—Black, white, and brown.
Material.—Wool.

Remarks.—Cradle has ten ribs, bound in couples. Cords imitate snakes. Condition, poor.

Specimen No. 301043.—A tassel. Locality: Nasca region.

Colors.—Red, green, blue, and yellow.

Design.—Four conventionalized faces superimposed on each side of the top of the tassel.

Material.—Wool.

Remarks.—The cord is elaborately braided and it has a flat cross-section. Condition, good, but incomplete. (See pl. 22, fig. 2.)

Specimen No. 301044.—Sling of the ribbed type. *Locality.*—Nasca region.

Colors.—Brown and black.

Material.—Wool.

Remarks.—The fact that the sling has been hastily but firmly knotted together suggests that it got torn in some combat.

Specimen No. 301045.—A tassel. *Locality.*—Nasca region.

Color.—Brown.

Material.—Wool.

Remarks.—Condition bad.

Specimen No. 301046.—Part of a sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Red, green, and white.

Design.—Geometric, serpentine. (See pl. 22, fig. 3.)

Material.—Cotton and wool.

Remarks.—The only cotton sling in the collection. The white cotton foundation has been treated with some sort of a chalky preparation to make it white. Upon this ground an attractive design has been embroidered in woolen threads. The delicate nature of the specimen makes it seem likely that it was ceremonial rather than utilitarian. Condition, fragmentary.

Specimen No. 301047.

Remarks.—The remainder of the cradle of No. 301046.

Specimen No. 301048.—Sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Dark brown and light brown.

Design.—Geometric and rather elaborate; zoomorphic element is seen in the conventionalized llamas. The design is broken up into a number of small panels or sections.

Material.—Wool.

Remarks.—The technique is such that those figures which are dark brown on one side of the fabric are light brown on the other side. No two of the panels on either side are alike. (See pl. 22, fig. 4.) Condition, fair.

Specimen No. 301049.—Sling of the solid-cradled type. *Locality.*—Lomas.

Remarks.—Much like No. 302048, but simpler.

Specimen No. 301050.—Sling of the solid-cradled type. *Locality.*—Lomas.

Remarks.—Much like No. 301048, but simpler.

Specimen No. 301051.—Part of a sling. *Locality.*—Lomas.

Remarks.—Much like No. 301048.

Specimen No. 301052.—Part of a sling. *Locality.*—Lomas.

Remarks.—Part of the same sling as No. 301051.

Specimen No. 301053.—Part of a sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Dark brown and light brown.
Design.—Of same sort as that on No. 301048.
Material.—Wool.

Specimen No. 301054.—Part of a sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Dark brown and light brown.
Design.—Elaborate geometric of same sort as that on No. 301048. (See pl. 25, fig. 1.)
Material.—Wool.
Remarks.—There is a perfectly definite warp upon which the fabric is built up.

Specimen No. 301055.—Part of a sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Black, white, and light brown.
Design.—Geometric and of same sort as that in No. 301048.
Material.—Wool.

Specimen No. 301056.—Sling of the solid-cradled type. *Locality.*—Lomas.

Colors.—Red, dark brown, and light brown.
Design.—Narrow border of red; central design of longitudinal zigzag in other colors. Technique the same as in No. 301048.
Material.—Wool.

Specimen No. 301057.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red, green, yellow, black, and white.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—Condition, fragmentary.

Specimen No. 301058.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red and yellow.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—Condition, poor.

Specimen No. 301059.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red and yellow.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—There is a fine red-and-yellow tassel. Condition, fragmentary.

Specimen No. 301060.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red, yellow, brown, green, and white.
Design.—Geometric and very delicate.
Material.—Wool.
Remarks.—This sling is so small and delicate as to suggest that it was either for some ceremonial purpose or for use by a young boy. Condition, fragmentary.

Specimen No. 301061.—Sling of the solid-cradled type. Locality: Lomas.

Colors.—Yellow (or light brown) and dark brown.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—The texture is rather coarse and rough. Like No. 301044, this sling has been torn and then mended later.

Specimen No. 301062.—Sling of the solid-cradled type. Locality: Lomas.

Colors.—Dark brown and white.
Design.—Mixture of the two colors.
Material.—Wool.
Remarks.—The texture of this sling is coarser than that of most of the specimens. Condition, fair.

Specimen No. 301063.—Part of a sling. Locality: Lomas.

Colors.—Red, green, buff, blue.
Design.—The four colors braided irregularly together.
Material.—Wool.
Remarks.—Condition, fragmentary.

Specimen No. 301064.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red and yellow.
Design.—Mixture.
Material.—Wool.
Remarks.—There is a tassel, in fragmentary condition.

Specimen No. 301065.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Light brown and dark brown.
Design.—Simple and geometric.
Material.—Wool.
Remarks.—Condition, fragmentary.

Specimen No. 301066.—Part of a sling of the solid-cradled type. Locality: Lomas.

Colors.—Red, yellow, and green.

Design.—Elaborate and geometric.

Material.—Wool.

Remarks.—The fabric is built up by crosswise weaving on a series of warps. It is true weaving, differing from most of the specimens in this respect. Condition, fragmentary.

Specimen No. 301067.—Part of a sling of the solid-cradled type. Locality: Lomas.

Remarks.—Part of the same sling as No. 301066. (See pl. 22, fig. 5.)

Specimen No. 301068.—Part of a sling of the solid-cradled type. Locality: Lomas.

Remarks.—Part of the same sling as Nos. 301066 and 301067.

Specimen No. 301069.—Part of a sling of the solid-cradled type Locality: Lomas.

Colors.—Red and yellow.

Design.—Simple and geometric.

Material.—Wool.

Specimen No. 301070.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Red and yellow.

Design.—Eight rows of step-sided diamonds in yellow on a red ground.

Material.—Wool.

Remarks.—Cradle has 15 ribs, bound firmly together. Foundation of the ribs is white wool cord. Probably this cradle belonged to a sling of the same sort as No. 301014. Condition, fragmentary.

Specimen No. 301071.—Sling of the ribbed type. Locality: Lomas.

Colors.—Red, blue, green, and buff.

Design.—On cradle, symmetrical arrangement of patches of all the colors; on flat part of cord, a symmetrical mixture of red and buff. (See pl. 25, fig. 2.)

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Wherever two patches of the same color come opposite one another on both pairs of ribs, the two pairs are bound together. As a result of the symmetrical arrangement of the patches of color, the gaps between the two pairs of ribs are also symmetrical. For a short space at both ends of the cradle there are three ribs, not four, and they are all bound together. A large part of each cord is flat in cross-section, the rest being round. There is one fine tassel left. Condition, fair.

Specimen No. 301072.—Sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.

Material.—Wool.

Remarks.—One of the two tassels is black, the other is white. Cradle has four ribs, bound in pairs. The ribs are unusually thick.

Specimen No. 301073.—Sling of the ribbed type. Locality: Lomas.

Colors.—Red, black, and white.

Design.—On cradle, checkerboard pattern in black and white. The two tassels are red. (See pl. 25, fig. 3.)

Material.—Wool.

Remarks.—The cords are thicker than most. Cradle has four ribs, bound in pairs. Condition, good.

Specimen No. 301074.—Sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. One of the two tassels is white; the other is black. The black tassel is very clumsily attached to its cord; the white one is much neater. Condition, good.

Specimen No. 301075.—Sling of the ribbed type. Locality: Lomas.

Colors.—Red, green, blue, and buff.

Design.—Symmetrical arrangement of the four colors on the cradle, as in No. 301071. The flat part of the cord is buff and red.

Material.—Wool.

Remarks.—Cradle has four ribs, bound firmly together. The two fine long tassels are red and yellow. Condition, fair.

Specimen No. 301076.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301075. Condition, poor.

Specimen No. 301077.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Red, white, and black.

Design.—Stripes.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301078.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Very much like No. 301073, but having a smaller cradle.

Specimen No. 301079.—Sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301080.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—White and brown.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs, one pair being broken. Condition, bad.

Specimen No. 301081.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301080.

Specimen No. 301082.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301083.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs, one pair being broken. Condition, bad.

Specimen No. 301084.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301085.—Sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Design.—On cradle, checkerboard pattern.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, good.

Specimen No. 301086.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle is entirely black; cords are white. Cradle has four ribs, bound in pairs. Condition, fair.

Specimen No. 301087.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301086.

Specimen No. 301088.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Brown and white.
Remarks.—The remaining cord has a knot in it, otherwise specimen is much like No. 301086.

Specimen No. 301089.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301086.

Specimen No. 301090.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—All white, otherwise much like No. 301086.

Specimen No. 301091.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Cradle brown, cords white, otherwise much like No. 301086.

Specimen No. 301092.—Sling of the ribbed type. Locality: Lomas.

Colors.—Cradle white with black border, otherwise much like No. 301086.

Specimen No. 301093.—Sling of the ribbed type. Locality: Lomas.

Remarks.—Tassel has some red in it, otherwise much like No. 301086.

Specimen No. 301094.—Part of a cradle of the ribbed type. Locality: Lomas.

Remarks.—Small in size, otherwise much like 301086.

Specimen No. 301095.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301086.

Specimen No. 301096.—Part of a sling of the ribbed type. Locality: Lomas.

Remarks.—Much like No. 301086.

Specimen No. 301097.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Brown, black, and white.
Design.—On cradle, a symmetrical arrangement of patches of the three colors.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, fragmentary.

Specimen No. 301098.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white, arranged in patches.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs throughout their length, but the pairs, in turn are bound together in two places. Condition, fragmentary.

Specimen No. 301099.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has three ribs, bound together. Condition, fragmentary.

Specimen No. 301100.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Brown and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, poor.

Specimen No. 301101.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black, white and light brown.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301102.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Black, white and brown.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs, one pair being broken. Condition, bad.

Specimen No. 301103.—Sling of the ribbed type. Locality: Lomas.

Colors.—Brown, white and black.

Design.—Stripes. (See pl. 25, fig. 4.)

Material.—Wool.

Remarks.—There are two cradles, each with four ribs, bound in pairs. The two cradles lie over and parallel with one another. Probably the missile went between them, like a nut in a nut-cracker. The two cradles are held together by two strands at one end and by three at the other, the strands being carried across the ends of both cradles. Condition, fragmentary but fairly good.

Specimen No. 301104.—Part of a sling of the ribbed type. Locality: Lomas.

Colors.—Brown, black, and white.

Design.—Cradle, white with black border, like No. 301092. Tassel, white.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, fair.

Specimen No. 301105.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Black, white, and red.

Remarks.—Much like No. 301104.

Specimen No. 301106.—Cradle of a sling of the ribbed type. Locality: Lomas.

Colors.—Red, white, and black.

Material.—Wool.

Remarks.—Cradle has four ribs, bound in pairs. Condition, poor.

Specimen No. 301107.—Sling of the ribbed type. Locality: Lomas.

Colors.—Brown, black, and white.

Material.—Wool.

Remarks.—Cord at one end of sling is white; at other end is a black loop tied to the cradle. Cradle has four ribs, bound in pairs.

Specimen No. 301108.—Sling of the ribbbed type. Locality.—Lomas.

Colors.—Black and white.

Material.—Wool.

Remarks.—Cords are thicker than usual. Cradle has four ribs, bound in pairs.

Specimen No. 301109.—Sling of the ribbed type. Locality.—Lomas.

Colors.—Black and white.

Material.—Wool.

Remarks.—Both cords and tassel are thicker than usual. Cradle has four ribs, bound in pairs.

Specimen No. 301110.—Part of a sling of the ribbed type. Locality.—Lomas.

Colors.—Crade, black; cords, white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound firmly together. Condition, fragmentary.

Specimen No. 301111.—Part of a sling of the ribbed type. Locality.—Lomas.

Colors.—Cradle, black; cords, white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, bad.

Specimen No. 301112.—Part of a sling of the ribbed type. Locality.—Lomas.

Colors.—Black, white, red and brown.
Design.—Cradle is black, white, and red; cords are brown, black, and white. Tassel is black.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301113.—Sling of the ribbed type. Locality—Lomas.

Colors.—Brown, black, and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301114.—Sling of the ribbed type. Locality.—Lomas.

Colors.—Red, brown, buff, and white.
Design.—Patches of color symmetrically arranged. (See pl. 26, fig. 1.)
Material.—Wool.
Remarks.—Cradle has eight small ribs, arranged in two major groups of four ribs each. Both the major groups comprise two minor groups, each of which has two ribs. The major groups are distinct throughout their length, but the two sets of minor groups in each major group are locked together at frequent intervals.

Specimen No. 301115.—Part of a sling of the ribbed type. Locality.—Lomas.

Colors.—Brown and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, bad.

Specimen No. 301116.—Sling of the ribbed type. Locality.—Lomas.

Colors.—Brown and white.
Material.—Wool.

Remarks.—One of the cords has a loop at the end 2 inches long. Cradle has four ribs, bound in pairs. The small size of the sling suggests that it was for use by a boy. Condition, fair.

Specimen No. 301117.—Sling of the ribbed type. Locality.—Lomas.

Colors.—Brown, red, and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, bad.

Specimen No. 301118.—Cradle of a sling of the ribbed type. Locality.—Lomas.

Colors.—Brown.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301119.—Two ropes with tassels. Locality.—Lomas.

Colors.—Ropes and tassels brown; small cord joining them white.
Material.—Wool.
Remarks.—Possibly part of a sling. Condition, fragmentary.

Specimen No. 301120.—Rope and tassel. Locality: Lomas.

Colors.—Dark brown, red and yellow.
Material.—Wool.
Remarks.—The brown rope has, near the tassel, a woven cover of red and yellow. Condition, fragmentary.

Specimen No. 301121.—Tassel. Locality: Lomas.

Remarks.—Tassel white, otherwise like No. 301120.

Specimen No. 301122.—Tassel. Locality: Lomas.

Remarks.—Dark brown tassel hanging from white cord.

Specimen No. 301123.—Tassel. Locality: Lomas.

Colors.—Red, green, buff, and purple.
Material.—Wool.
Remarks.—Cords in the tassel have been knotted near the bottom to prevent their unraveling.

Specimen No. 301124.—Sling of ribbed type. Locality: Coyungo.

Colors.—Dark brown, light brown, and white.
Design.—Geometric. (See pl. 26, fig. 2.)
Material.—Wool.
Remarks.—The portion of the cords which is nearest the cradle is braided in such a way as to have a flat cross-section. This part is brown and white. Round part of cords is white. Cradle has three divisions in point of design. In the first and third division there are five ribs, bound together, and decorated with five step-sided diamonds, dark brown, bordered with white, on a black ground. Middle division also has five ribs, three black ones being bound together and two white ones together. This tripartite subdivision of the cradle is important. This is the longest sling in the collection (twenty-eight feet). Condition, good. There are the remains of a tassel at both ends. Undoubtedly this sling was ceremonial.

Specimen No. 301125.—Sling of the ribbed type. Locality: Coyungo.

Colors.—Dark brown, light brown, and white.

Design.—Geometric.

Material.—Wool.

Remarks.—Save for the fact that the central division of the cradle of this sling has four and not five ribs, it is essentially similar to No. 301124.

Specimen No. 301126.—Sling of the ribbed type. Locality: Coyungo.

Remarks.—A duplicate of No. 301125.

Specimen No. 301127.—Sling of the ribbed type. Locality: Coyungo.

Colors.—Red, buff, black, and white.

Design.—Diamond pattern. (See pl. 26, fig. 3.)

Material.—Wool.

Remarks.—The cradle has the tripartite subdivision noted in No. 301124. Here the middle division has eight ribs, bound in groups of four. The end divisions have three ribs at their outer ends and eight toward the center of the cradle. The ribs in the end divisions are bound firmly together. A large part of either cord is flat and braided. Probably this sling was for ceremonial purposes. There is a small tassel at each end.

Specimen No. 301128.—Sling of the ribbed type. Locality: Coyungo.

Remarks.—A duplicate of No. 301127.

Specimen No. 301129.—Sling of the ribbed type. Locality: Coyungo.

Remarks.—Similar to Nos. 301124 and 301127.

Specimen No. 301130.—Sling of the ribbed type. Locality: Coyungo.

Remarks.—A duplicate of No. 301129.

Specimen No. 301131.—Sling of the ribbed type. Locality.—Coyungo.

Colors.—Black and white.

Material.—Wool.

Remarks.—Central division of cradle (which shows tripartite subdivision) has four ribs, bound in pairs. The colors are arranged checkerboard fashion. A large portion of each cord is flat and braided. Very similar to No. 301124.

Specimen No. 301132.—Sling of the ribbed type. Locality.—Coyungo.

Remaks.—Save for the fact that the colors are dark brown, light brown, and white, this sling is much like No. 301131.

Specimen No. 301133.—Sling of the ribbed type. Locality.—Coyungo.

Remarks.—Save for the fact the colors are red, yellow, black, and white, this sling is much like No. 301131.

Specimen No. 301134.—Sling of the ribbed type. Locality.—Coyungo.

Remarks.—Save for the fact that the colors are dark brown and white, this sling is much like No. 301124.

Specimen No. 301135.—Sling of the ribbed type. Locality.—Coyungo.

Remarks.—Colors are black and white; otherwise much like No. 301124.

Specimen No. 301136.—Part of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Red, yellow, and black.

Design.—Five rows of step-sided diamonds, the two outer and middle rows being black bordered with yellow, and the other two rows being red bordered with yellow. Cord has a snakelike pattern of rings in black, brown, and white. (See pl. 27, fig. 1.)

Remarks.—Cradle has twenty-four slender ribs, bound together. Condition, poor.

Specimen No. 301137.—Cradle of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Red, yellow, and black.

Design.—Cradle red with yellow and black border.

Material.—Wool.

Remarks.—Cradle has six ribs at the center, the number diminishing toward the ends, as in No. 301005. Condition, fragmentary.

Specimen No. 301138.—Part of a sling of the ribbed type. Locality.—Coyungo.

Remarks.—A duplicate of No. 301137.

Specimen No. 301139.—Part of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Dark brown and white. (See pl. 27, fig. 2.)

Remarks.—Tassel is yellow; otherwise like No. 301137.

Specimen No. 301140.—Part of a sling of the ribbed type. Locality.—Coyungo.

Remarks.—Probably part of No. 301139.

Specimen No. 301141.—Part of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Red, yellow, and black.

Remarks.—Similar to No. 301137.

Specimen No. 301142.—Part of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Cradle yellow with black border; otherwise like No. 301141

Specimen No. 301143.—Part of a sling of the ribbed type. Locality.—Coyungo.

Colors.—Dark brown and white. (See pl. 27, fig. 2.)
Material.—Wool.
Remarks.—Cradle has six ribs, bound in groups of three.

Specimen No. 301144.—Sling of the ribbed type. Locality: Acari valley.

Colors.—Black and white. (Faded and stained.)
Material.—Wool.
Remarks.—Cradle has four rather thick ribs, bound in pairs. The cords are very thick and clumsy. Condition, very bad.

Specimen No. 301145.—Sling of the ribbed type. Locality: Acari valley.

Colors.—Dark brown and light brown.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs. Condition, very bad.

Specimen No. 301146.—Part of a sling of the ribbed type. Locality: Acari valley.

Colors.—Black and white.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301147.—Sling of the ribbed type. Locality: Acari valley.

Colors.—Dark brown and light brown.
Remarks.—Cradle has four ribs, bound in pairs, one pair being broken. Condition, bad.

Specimen No. 301148.—Part of a sling of the ribbed type. Locality: Acari valley.

Colors.—Brown and yellowish.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301149.—Part of a sling of the ribbed type. Locality: Acari valley.

Colors.—Dark brown, light brown, and black.
Material.—Wool.
Remarks.—Cradle has four ribs, bound in pairs.

Specimen No. 301150.—Part of a sling of the ribbed type. Locality: Acari valley.

Remarks.—A duplicate of No. 301149.

Specimen No. 301151.—Part of a sling of the ribbed type. Locality: Acari valley.

Colors.—Red, dark brown, and light brown.
Material.—Wool.

Design.—Intricate and geometric. (See pl. 27, fig. 3.)

Remarks.—Cradle has 12 ribs, bound in six pairs.

Specimen No. 301152.—Sling of the ribbed type. Locality: Acari valley.

Colors.—Dark brown, red, and white.

Material.—Wool.

Remarks.—Cradle has eight ribs, bound in two sets of four. This sling was probably used by a young boy.

Specimen No. 301153.—Sling of the ribbed type. Locality: Coyungo.

Colors.—Dark brown and light brown.

Design.—Step-sided brown diamonds on black, on cradle. Tripartite subdivision of cradle, middle division only is decorated.

Material.—Wool.

Remarks.—Cradle has five ribs, bound together throughout. Cord partly flat.

Specimen No. 301154.—Sling of the ribbed type. Locality: Coyungo.

Colors.—Dark brown and white.

Material.—Wool.

Remarks.—Cradle has tripartite subdivision. Four ribs, bound in pairs.

Specimen No. 301155.—Sling of the ribbed type. Locality: Coyungo.

Remarks.—A duplicate of No. 301154.

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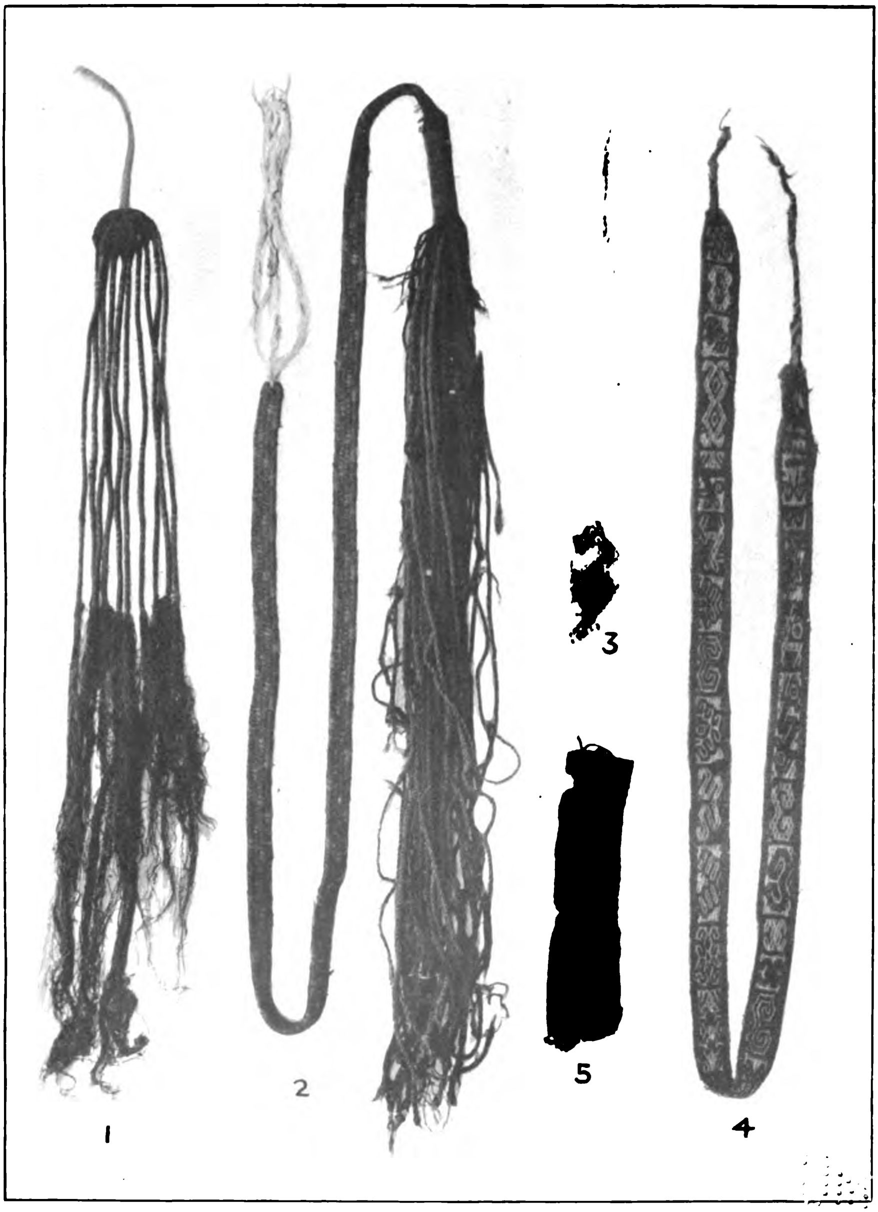

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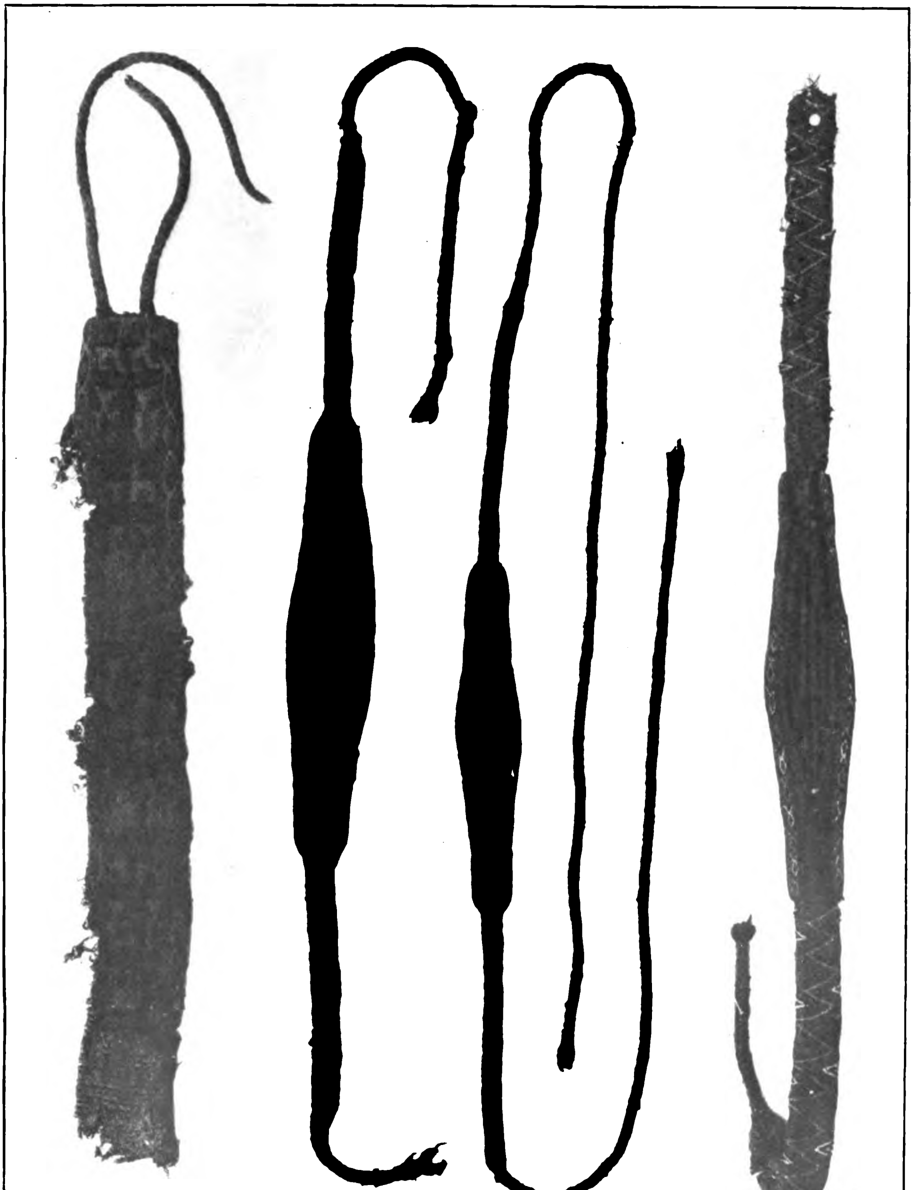

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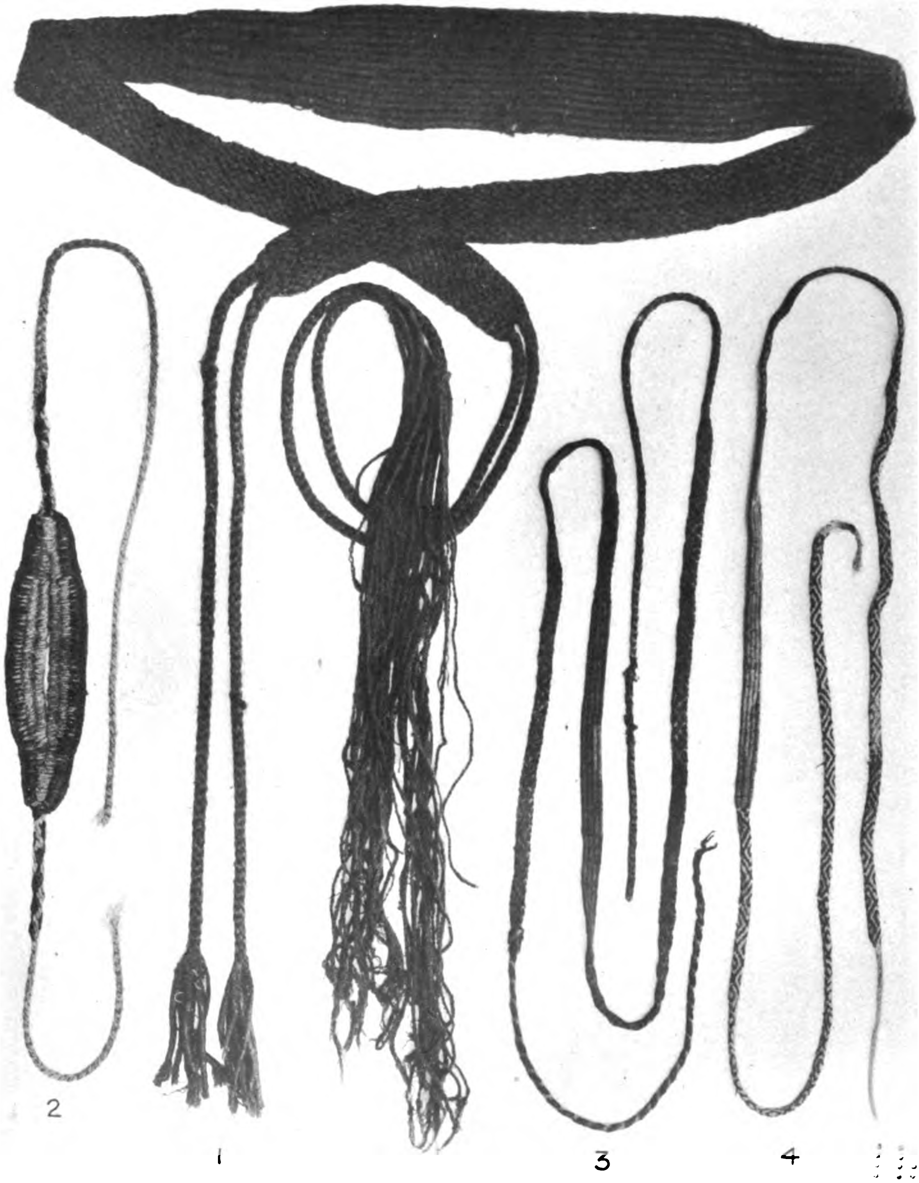

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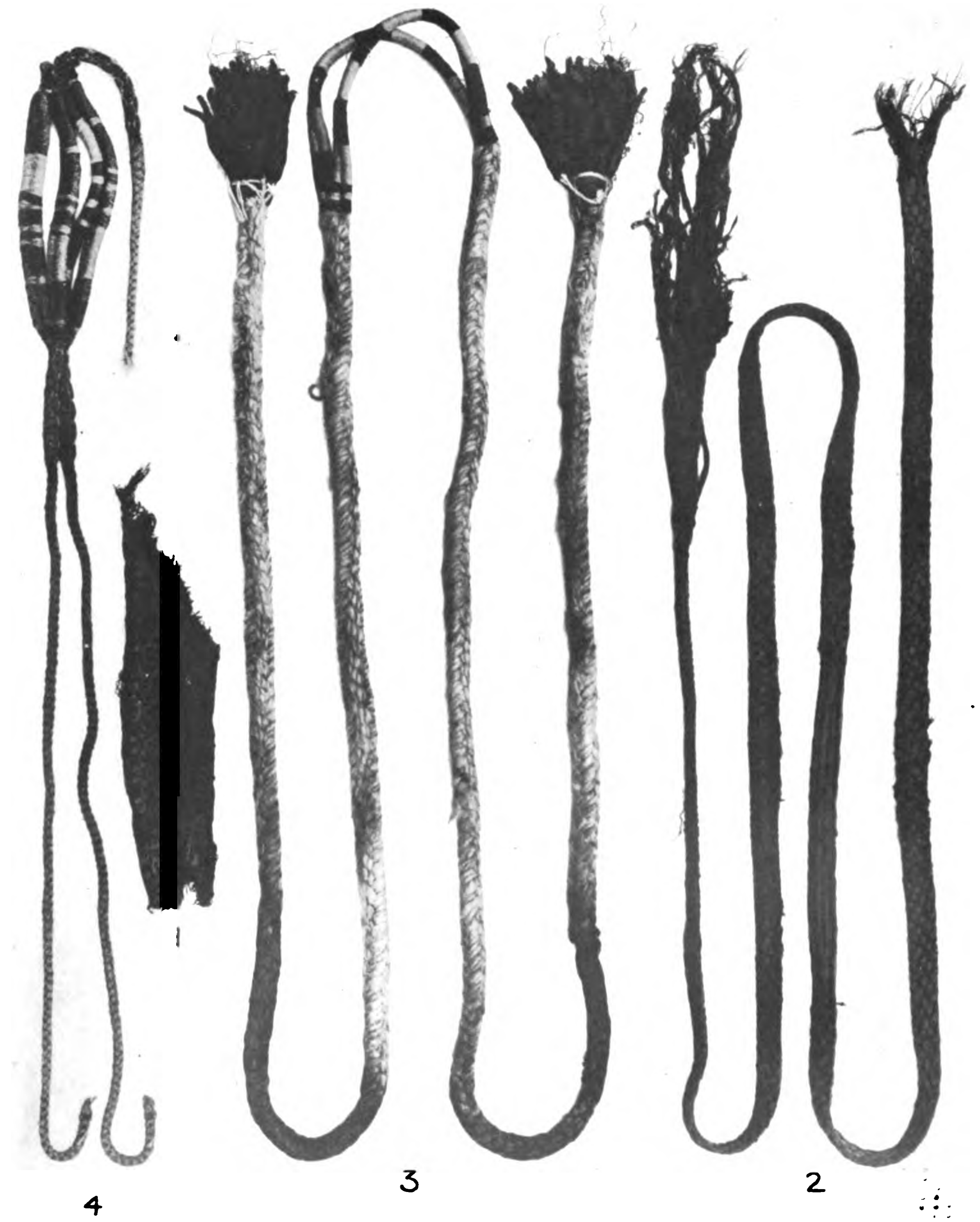

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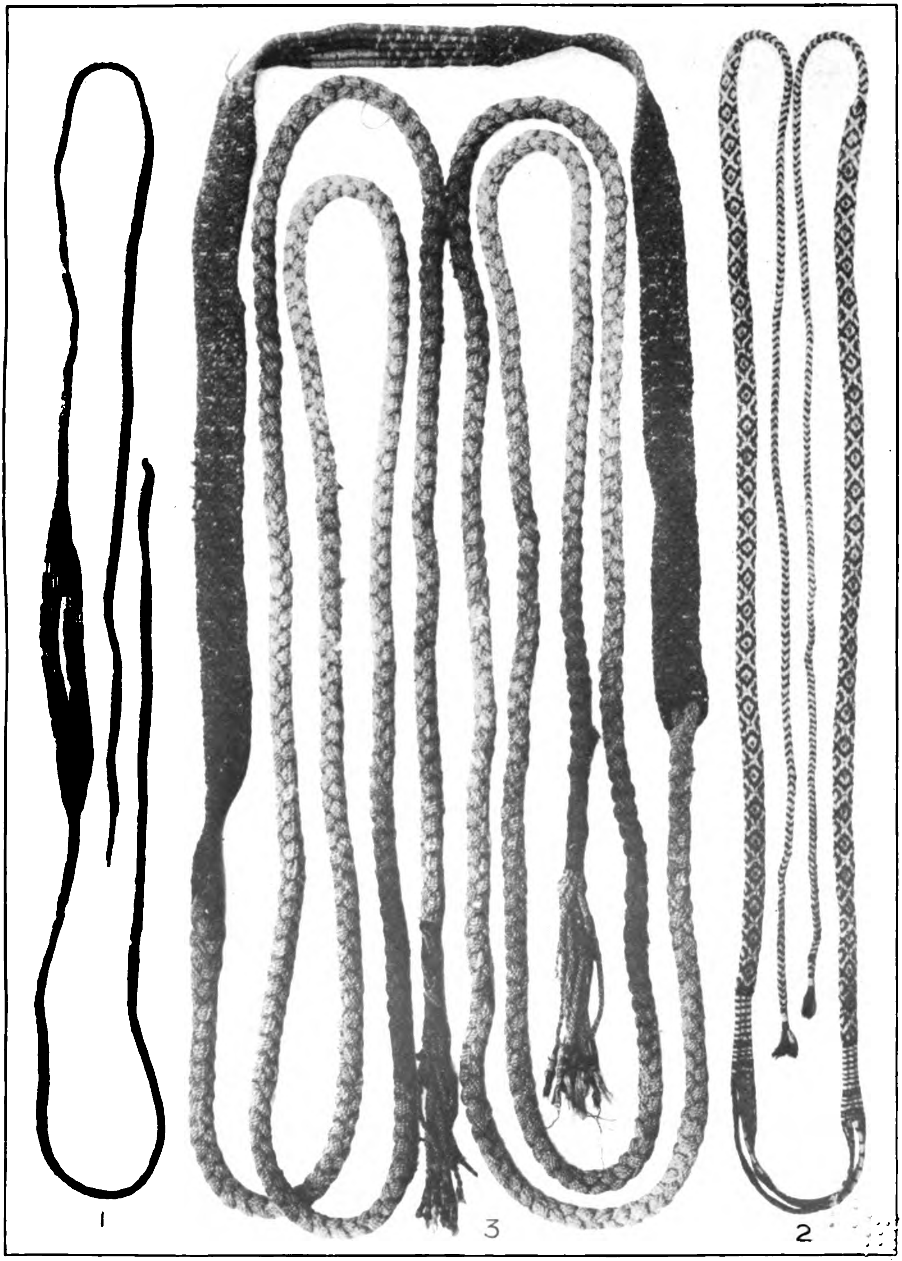
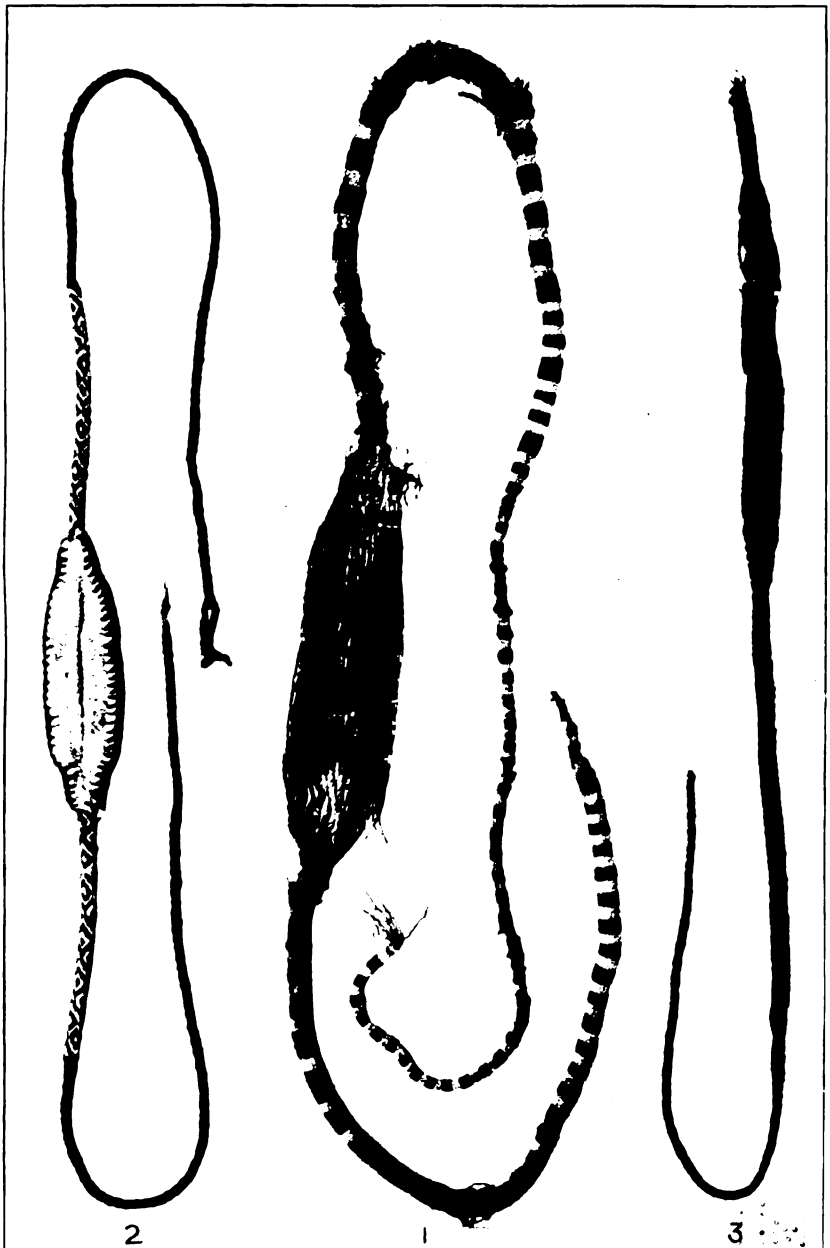


SLINGS FROM LOMAS AND FROM COYUNGO, PERU.



SLINGS FROM COYUNGO AND FROM ACARI, PERU.

A REVISION OF THE SUBSPECIES OF THE WHITE-COLLARED KINGFISHER, SAUROPATIS CHLORIS (BODDAERT).

By Harry C. Oberholser,

Of the Biological Survey, United States Department of Agriculture.

The present revision of the races of *Sauropatis chloris* is based primarily on the collection of the United States National Museum, chiefly specimens contributed by Dr. W. L. Abbott. In addition, the writer is indebted for the loan of material to the Academy of Natural Sciences of Philadelphia, through Dr. Witmer Stone; the Museum of Comparative Zoölogy at Cambridge, Massachusetts, through Mr. Outram Bangs; the American Museum of Natural History, through Dr. F. M. Chapman; and also to Mr. J. H. Fleming, of Toronto, Ontario, Canada.

The total number of specimens examined is 386, representing very satisfactorily most of the recognizable subspecies. Several of the races, apparently valid, it has not been possible to verify, but we have, however, included these for the sake of completeness.

The names of colors of which use is here made are based on Mr. Ridgway's "Color Standards and Color Nomenclature." Measurements are all in millimeters, and have been taken as explained in the author's paper on *Butorides virescens*.[1] By far the greater part of the specimens examined will be found duly entered in the tables of measurements; in fact, *Sauropatis chloris collaris* is the only form of which practically all are not so listed. Furthermore, those not used in the diagnostic measurement averages are indicated.

The literature pertaining to *Sauropatis chloris* is not so extensive as would be expected for so well-known and difficult a group. The most important references are:

Blanford, W. T.—The Fauna of British India, Birds, vol. 3, 1895, pp. 135–137.

Sharpe, R. B.—Catalogue of the Birds in the British Museum, vol. 17, 1892, pp. 272–283.

Hartert, Ernst.—Novitates Zoologicae, vol. 11, No 1, March 25, 1904, pp. 197–199.

This species is commonly placed in the genus *Halcyon* Swainson, but it is without doubt to be segregated from that group, as already done by Mr. G. M. Mathews[1] and the writer.[2] Its proper generic name will therefore become *Sauropatis* Cabanis and Heine,[3] of which the type is *Halcyon sanctus* Vigors and Horsfield, by subsequent designation of Sharpe.[4] This genus differs from *Halcyon* Swainson (type, *Alcedo senegalensis* Linnaeus) in having the culmen practically straight instead of convex; the commissure curved downwards; the gonys convex instead of practically straight; and the first primarily (counting from the outermost) nearly as long as the second and third which are about the same length, and the longest reaching very much beyond the fifth and sixth, instead of being much shorter.

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[1] Proc. U. S. Nat. Mus., vol. 42, 1912, p 583.

From the genus *Entomothera* Horsfield (type, *Alcedo coromanda* Latham), *Sauropatis* may be distinguished by relatively longer wings; wider, more oval (less linear) and more exposed nostrils; and by the relative lengths of the primaries as from *Halcyon*.

In the genus *Sauropatis*, then, *Sauropatis chloris* (Boddaert) belongs to a group of rather closely allied species, which includes, among others, *Sauropatis sancta* (Vigors and Horsfield), *Sauropatis occipitalis* (Blyth), *Sauropatis sacra* (Gmelin), and *Sauropatis owstoni*[5] (Rothschild), which last, indeed, may prove to be a subspecies of *Sauropatis chloris*.

With *Sauropatis chloris* are included a considerable number of forms, some of which have been treated as subspecies, some as distinct species. They present a difficult problem, one of the most difficult in the family Alcedinidae, as all who have studied them are doubtless prepared to admit, chiefly because of the great amount of variation, sexual, seasonal, and, individual, in both size and color. This variation has been hitherto too little understood or allowed for, and considerable confusion as well as some useless synonyms have been the result. A good series must be had finally to establish the characters of the forms, for comparisons need to be made with birds of the same sex, age, and condition of plumage. These characters are, in this species, principally in the dimensions of bill, wing, tail, and tarsus; the width and conspicuousness of the blackish nuchal band; the presence or absence of buffy suffusion on the white cervical collar and under parts; the bluish, greenish, or brownish colors of the upper parts, including the wings; the presence or absence of a superciliary stripe; the size of the white concealed occipital patch, and of the light supra-loral spot.

These differences between the various forms of *Halcyon chloris* are in most instances not more than average. and even in those races that are separated by water barriers from their nearest relatives, are bridged by individual variation so completely that notwithstanding the attempt of some authors to maintain several distinct species, it is quite certain that all of the recognizable forms are but subspecies of *Sauropatis chloris.* Furthermore, probably none of the races are migratory, so that the supposed occurrences of one race within the range of another are to be explained by intergradation or individual variation.

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[1] Austral Avian Record, vol. 1, No. 5, Dec. 24, 1912, pp. 108–109.

[2] Proc. U. S. Nat. Mus., vol. 52, Feb. 8, 1917, p. 189.

[3] Mus. Hein., pt. 2, January, 1860, p. 158.

[4] Mon. Alced., vol. 1, 1871, introduction.

[5] Bull. Brit. Ornith. Club, vol. 15, No. CIX, Nov. 1, 1904, p. 6 (Marianne Islands).

In most cases the females are distinguishable from the males by duller, more greenish upper parts, more extensively blackish auriculars, and sometimes lack of buff on the sides and flanks; but there appears to be more difference in some races than in others. There are in some cases other characteristics of the female, though no difference of size, so far as we have been able to discover.

The juvenal plumage differs from that of the adult in having the pileum more brownish; remaining upper parts duller and more greenish and more or less tinged with brownish; black nuchal band often more conspicuous; back just below the white cervical collar more or less blackish; tail and wings duller, less bluish (more greenish or brownish); white cervical collar more buffy, and its feathers edged with dusky; supraloral spot more buffy; ear-coverts more blackish (less greenish); and breast feathers margined with dusky.

Immature birds of the first winter, as compared with adults, are duller and more brownish or greenish on the upper surface, like the adult female, but even darker, though more like the adult than is the juvenal plumage, and have the feathers of the breast, the white cervical collar, the sides of neck and of body slightly edged with dusky; also the feathers of the forehead margined with buffy white. The greenish shade of the upper surface persists after other immature features have disappeared, so that very bluish birds are apparently old individuals. Adult birds in worn plumage are likewise decidedly more bluish above than when in fresh condition, though this does not seem materially to affect the wing-quills; have the black nuchal band broader, less washed with greenish, and the ear-coverts more blackish. On the other hand, freshly molted adults have often, if not always, a few slight dusky tips on the lower parts and on the white cervical collar. These soon wear off, however, leaving the parts pure white or buffy as the case may be.

The molt of the juvenal plumage into that of the first winter takes place between the first of September and the middle of January, chiefly during October and November. Apparently, however, the full adult dress is not acquired until the bird is at least a year and a quarter old, possibly even more. The adult molts but once a year, between the middle of September and the middle of January.

A single example of *Sauropatis chloris cyanescens*, No. 180518, U.S.N.M., from the island of Banka, taken, May 21, 1904, shows some evidences of molt at even that late date.

Individual variation concerns chiefly the length of wing; size of bill; width and distinctness of the black nuchal band; the amount of greenish or bluish on the auriculars; and the greenish, bluish, or brownish shade of the upper parts, including the wings and tail.

The faunal distribution of *Sauropatis chloris* as a species lies principally in the Australian and Oriental regions, but one form. *Sauropatis chloris abyssinica*, reaches the northeastern part of the Ethiopian Region. The geographic range extends north to the Philippine Islands, Siam, India, and Abyssinia; west to Abyssinia; south to western India, Java, middle western and northern Australia; and east to the Fiji Islands, the Solomon Islands, and the Pelew Islands.

The number of subspecies here recognized is 24; and it is interesting to note that of these only six, including three found in Australia, are continental in distribution; while these continental forms, excepting the three in Australia, occupy widely separated ranges. The subspecies of *Sauropatis chloris*, with their type localities, are as follows:

Name.	Type locality.
Sauropatis chloris chloris	Buru Island, Molucca Islands.
Sauropatis chloris teraokai	Pelew Islands.
Sauropatis chloris forsteni	Gorontalo, northern Celebes.
Sauropatis chloris meyeri	Togian Islands.
Sauropatis chloris enigma	Salibabu Island, Talaut Islands.
Sauropatis chloris collaris	Manila, Luzon Island, Philippine Islands.
Sauropatis chloris cyanescens	Pulo Taya, off the southeastern coast of Sumatra.
Sauropatis chloris palmeri[1]	Goenoeng Boender, Mount Salak, Java.
Sauropatis chloris armstrongi	Siam.
Sauropatis chloris davisoni	Aberdeen, South Andamans.
Sauropatis chloris azela[2]	Engano Island, Barussan Islands, western Sumatra.
Sauropatis chloris chloroptera[3]	Sibabo Bay, Simalur Island, Barussan Islands, western Sumatra.
Sauropatis chloris amphiryta[4]	Lifau, Nias Island, Barussan Islands, western Sumatra.
Sauropatis chloris vidali	Kelsi Creek, South Konkan, western India.
Sauropatis chloris abyssinica	Coast of Red Sea, Abyssinia.
Sauropatis chloris anachoreta	Hermit Islands, in the western Admiralty Islands, off northeastern New Guinea.
Sauropatis chloris solomonis	Ugi Island, Solomon Islands.
Sauropatis chloris hyperpontia[5]	Havannah Harbor, Vaté Island, New Hebrides Islands.
Sauropatis chloris suvensis	Suva Island, Fiji Islands.
Sauropatis chloris colonus	Egum Island, Louisiade Archipelago, off southeastern New Guinea.
Sauropatis chloris grayi	Aru Islands.
Sauropatis chloris colcloughi	Mud Island, near Brisbane, Queensland, Australia.
Sauropatis chloris sordida	Cape York, northern Queensland, Australia.
Sauropatis chloris melvillensis	Melville Island, Northern Territory, Australia.

All the races of *Sauropatis chloris* seem to be strictly resident. They inhabit chiefly, if not entirely, the coast regions along the seashore or tidal waters, and rarely wander far inland, though they ascend streams, occasionally even to an altitude of 4,500 feet. They are noisy, conspicuous birds, and therefore usually not hard to find. Their food consists mostly of crabs and other crustaceans, together with small fishes, lizards, insects, and centipedes.

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[1] New subspecies, see p. 369.

[2] New subspecies, see p. 377.

[3] New subspecies, see p. 379.

[4] New subspecies, see p. 382.

[5] New subspecies, see p. 386.

SAUROPATIS CHLORIS CHLORIS (Boddaert).

Alcedo Chloris BODDAERT, Tabl. Planch. Enlum. d'Hist. Nat., 1783, p. 49 (based on *Martin-Pêcheur à tete verte du Cap de Bonne Esperance*, d'Aubenton, Planch. Enlum., pl. 783, fig. 2; also on *Le Martin-Pêcheur a Tête Verte*, Buffon, Hist. Nat. des Oiseaux [ed. Montbeillard], vol. 13, 1780, p. 279; and the *Green-headed Kingfisher*, Latham, Gen. Synop. Birds, vol. 1, pt. 2, 1782, p. 620).

Alcedo chlorocephala GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 454 (Buru Island, Molucca Islands).

Halcyon chloris keiensis BERLEPSCH, Abhandl. Senckenb. Naturf. Gesell., vol. 34, Heft. 4, 1913, p. 494 (Warka, Great Kei Island, Kei Islands).

Subspecific characters.—Size large; auriculars usually blackish, with little green; a wide, black nuchal band; upper parts rather dark, distinctly greenish, and in the female, particularly on the head, somewhat brownish; exposed surface of wing-quills, especially the primaries, deep blue; sides and flanks with little or no buffy suffusion.

Description.—Adult male. Pileum dull green; back and scapulars dark green; a large, almost concealed patch of white on the occiput; a broad, black nuchal band; a broad, white cervical collar; lower back, rump, and upper tail-coverts green, more bluish than the interscapulum; wings fuscous, the exposed portions of wing-quills deep blue, the remainder of upper surface of wings more greenish; tail bluish green or greenish blue; lores black; supraloral spot creamy white; a narrow line over the eye and a spot on lower eyelid white; remainder of sides of head greenish, except auriculars which are mostly or wholly blackish; entire lower surface white.

Measurements.—Male[1]: Wing, 112.5 mm.; tail, 73; exposed culmen, 44; tarsus, 16.3.

Female[2]: Wing, 103–110.5 (average, 106.8) mm.; tail, 67.5–69 (68.2); exposed culmen, 42.3–45.5 (44.3); tarsus, 15.5–17 (16.2).

Both sexes: Wing, 103–112.5 (average, 108.3) mm.; tail, 67.5–73 (69.4); exposed culmen, 42.3–45.5 (44.2); tarsus, 15.5–17 (16.2)[3]. Wing, 108–120 (111.4).[4]

Type locality.—Buru Island, Molucca Islands.[5]

Geographic distribution.—East India Islands: north to the Molucca Islands, west to the Molucca Islands, and in the Lesser Sunda Islands to Lombok Island; south to Lombok Island, Timor Island, Sermata Island, and the Timorlaut Islands; and east to the Timorlaut, Kei, and Molucca islands.

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[1] One specimen, from the Molucca Islands.

[2] Three specimens, from the Molucca Islands.

[3] Four specimens, from the Molucca Islands.

[4] Ten specimens, measured by Hartert.

[5] See p. 356.

While there is a considerable range of individual variation in this race, particularly in size, the average characters are sufficiently marked to separate it readily from *Sauropatis chloris cyanescens* and *Sauropatis chloris collaris* on the one hand, and from *Sauropatis chloris solomonis* on the other. Dr. Hartert has already pointed out[1] most of these characters and outlined the general range of *Sauropatis chloris chloris.*

The adult female of this race differs from the adult male in having the auriculars even more uniformly blackish, with scarcely a trace of green, and the upper parts, including the exposed surface of wings and tail, duller and more greenish. The adult female is also slightly washed with pale buffy on the supraloral spot, flanks, breast, and white cervical collar.

The juvenal female has a stronger tinge of buff on the supraloral spot, sides, flanks, and white cervical collar than has the adult of the same sex, with also a slight wash of greenish on the black ear-coverts.

Boddaert was the first author to give this kingfisher a binomial name, and he christened it *Alcedo chloris,*[2] basing this on the *Martin-Pêcheur à tete verte du Cap de Bonne Esperance* of d'Aubenton[3]; *Le Martin-Pêcheur a Tête Verte* of Buffon[4]; and the *Green-headed Kingfisher* of Latham.[5] Buffon states[4] that the locality, Cape of Good Hope, given on d'Aubenton's plate, is erroneous, and that the bird really came from the island of Buru, in the Molucca group. Latham,[6] too, gives Buru Island as the locality of his "green headed kingfisher." It is thus clear that the type locality should be Buru Island, as Dr. E. Hartert has already explained.[7] Furthermore, Doctor Hartert at the same time definitely fixed Buru as the type locality,[7] so that even if we disregard the remarks of Buffon, as of course we should not do, the type locality would remain Buru Island from Doctor Hartert's designation. The subsequent action of Count von Berlepsch in selecting Java as the type locality[8] can, therefore, not stand. This author's *Halcyon chloris keiensis,*[9] based on the bird from the Kei Islands, described under the supposition that the birds from Java represented the typical form, seems, consequently, to be a synonym of *Sauropatis chloris chloris.* I have not, however, had specimens from the Kei Islands for examination, but, judging from the original description, there appear to be no characters to separate them from *Sauropatis chloris chloris.*

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[1] Novit. Zool., vol. 11, No. 1, Mar. 25, 1904, p. 198.
[2] Tabl. Planch. Enlum. d'Hist. Nat., 1783, p. 49.
[3] Planch. Enlum., pl. 783, fig. 2.
[4] Hist. Nat. des Oiseaux [ed. Montbeillard], vol. 13, 1780, p. 279.
[5] Gen. Synop. Birds, vol. 1, pt. 2, 1782, p. 620.
[6] *Loc. cit.*
[7] Novit. Zool., vol. 11, No. 1, Mar. 25, 1904, p. 197.
[8] Abhandl. Senckenb. Naturf. Gesells., vol. 34, Heft 1, 1911, p. 75.
[9] Idem, Heft 4, 1913, p. 494.

Measurements and localities of all the specimens examined are given in the following table:

Measurements of specimens of Sauropatis chloris chloris.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
M. C. Z. 53233.	Male....	Saonek, Waigiou Island, Molucca Islands.	Mar. —, 1907	T. Barbour.....	112.5	73	44	16.3
M. C. Z. 53232.	Female.	Piru, Ceram Island, Molucca Islands.	Feb. —, 1907	.....do.........	103	68	45	15.5
M. C. Z. 39684.	Female, im.	Amboina Island, Molucca Islands.	May 21, 1897	K. Schädler....	110.5	69	42.3	16
U.S.N.M. 178104.	...do....	.....do................	May 1, 1897	.....do.........	107	67.5	45.5	17

SAUROPATIS CHLORIS TERAOKAI (Kuroda).

Halcyon chloris teraokai KURODA, Tori, vol. 1, No. 2, 1915, p. 56 (Pelew Islands).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but averaging larger, with a narrower, less clearly blackish nuchal band, and somewhat less blackish auriculars.

Measurements.—Both sexes:[1] wing, 108–117 (average, 112.3) mm.; tail, 71–78 (73.7); culmen,[2] 51–56 (54.6); tarsus, 15.

Type locality.—Pelew Islands.

Geographic distribution.—Pelew Islands.

Remarks.—Although we have seen no specimens of this Pelew Islands race, it appears to be recognizable. It differs from *Sauropatis chloris collaris* in larger size, more bluish upper surface, and more blackish auriculars.

SAUROPATIS CHLORIS FORSTENI (Bonaparte).

Halcyon forsteni BONAPARTE, Consp. Generum Avium, vol. 1, 1850, p. 157 (Temminck MS.) (Gorontalo, Celebes).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but averaging somewhat smaller; male with back more bluish (less greenish), and thus less contrasted with the blue of wings; and nuchal collar less distinctly black, more overlaid with greenish or bluish; female with auriculars slightly more washed with greenish.

Measurements.—Male:[3] Wing, 100–115 (average, 107.4) mm.; tail, 60–75 (66.9); exposed culmen, 33.5–47 (41.8); tarsus, 14–17 (15.7).

Female:[4] Wing, 101.5–114 (average, 107.8) mm.; tail, 62–71.5 (66.8); exposed culmen, 34–47 (42.1); tarsus, 14–17 (15.9).

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[1] Five specimens from the Pelew Islands, measured by Mr. N. Kuroda.

[2] Probably *total* culmen.

[3] Seventeen specimens, from Celebes.

[4] Sixteen specimens, from Celebes.

Both sexes:[1] Wing, 100–115 (average, 107.6) mm.; tail, 60–75 (66.8); exposed culmen, 33.5–47 (41.9); tarsus, 14–17 (15.8).

Type locality.—Gorontalo, northern Celebes.

Geographic distribution.—Celebes, and probably its coastal islands.

Remarks.—This race is, in general characters, intermediate between *Sauropatis chloris chloris* and *Sauropatis chloris collaris*, as it is in geographic position. Although the specimen from Gorontalo, Celebes, on which Bonaparte based his *Halcyon forsteni*,[2] was undoubtedly very abnormal, as both Schlegel and Sharpe conclude, the name becomes, of course, available, now that the birds from this island prove to be subspecifically recognizable. This form seems, however, to be confined to Celebes and its coastal islands.

The female of *Sauropatis chloris forsteni* differs from the male in having the upper parts decidedly duller, more greenish or olivaceous (less bluish); the auriculars more blackish (less washed with greenish); and the black nuchal band on the average somewhat wider.

The colors of the soft parts, as shown by data on the labels of specimens, are as follows: Iris gray or black; bill black, the base of mandible flesh color; feet black.

Measurements and localities of all the specimens examined are subjoined.

Measurements of specimens of Sauropatis chloris forsteni.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
A. N. S. Phila. 50141.	Male....	Mt. Masarang, 3,000 feet, Celebes.	Oct. —, 1895	C. Hose........	107	69	43.5	15
U.S.N.M. 145159.	...do.....	Celebes....................	....	L. D. H. A. Duivenbode	109.5	68	42.5	16.5
U.S.N.M. 178105.	...do.....	Northern Celebes	—— —, 1883	V. Faber.......	108.5	66	44	16
J. H. Fleming 10996.	...do....	Totok, Minahasa, Celebes.	April —, 1899	A. Weigall.....	107	67	40	15.5
J. H. Fleming 10998.	...do....	.....do...............	May —, 1899	.....do.........	110	68.5	38.5	16.2
J. H. Fleming 10993.	Male, im.	Bojat, Minahasa, Celebes.	June —, 1899	.....do.........	108	65.5	40	15.3
J. H. Fleming 10988.	...do....	Kotta Buna, Minahasa, Celebes.	May —, 1899	.....do.........	111	67	43.8	15.2
M. C. Z. 39686.	...do....	Northern Celebes......	—— —, 1883	V. Faber.......	108.5	67	43.5	15.5
Am. Mus. N. H. 110957.	Male....	Dodepo Island, Tomini Gulf, Celebes.	Nov. 16, 1909	R. C. Andrews.	115	75	46	16
Am. Mus. N. H. 110953.	...do....	.....do..................	.....do.......	...do...........	112	70	43.5	16
U.S.N.M. 145158.	[Male]....	[Celebes]..............	....	L. D. H. A. Duivenbode.	109	67.5	37	17
U.S.N.M. 145157.	...do....	Celebes................	—— —, 1874	G. Fischer......	104	66	40.5	15.5

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[1] Thirty-three specimens, from Celebes.

[2] Consp. Generum Avium, vol. 1, 1850, p. 157.

Measurements of specimens of Sauropatis chloris forsteni—Continued.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
U.S.N.M. 249729.	Male....	Ayermadidi, Celebes..	May 5, 1916	H. C. Raven...	102	60	33.5	14.5
U.S.N.M. 249730.	...do....	Koeala Prang, Celebes.	June 18, 1916	.....do.........	106	67	44	15.5
U.S.N.M. 249731.	...do....	Manembo Nembo, Celebes.	June 23, 1916	.....do.........	107.5	66	41.5	15
U.S.N.M. 249204.	...do....	Likoepang, Celebes...	Feb. 24, 1916	.....do.........	100	62	47	15
U.S.N.M. 249205.	...do....	.....do................	Feb. 28, 1916	.....do.........	105	65	41	16.5
J. H. Fleming 10994.	Female.	Bojat, Minahasa, Celebes.	May —, 1899	A. Weigall.....	108	65	34	16.5
J. H. Fleming 10995.	...do....	.....do................	Mar. 13, 1899	.....do.........	114	70	40	16
J. H. Fleming 10992.	...do....	Kotta Buna, Minahasa, Celebes.	May —, 1899	.....do.........	104.5	62.8	42	16
J. H. Fleming 10987.	...do....	.....do................	...do........	.....do.........	106	67	39	15.2
J. H. Fleming 10989.	...do....	.....do................	.....do.......	.....do.........	108	66	44.5	15.5
M. C. Z. 11269.	...do....	Celebes...............	....	....	109	67.5	46.3	16.2
Am. Mus. N. H. 110955.	...do....	Dodepo Island, Tomini Gulf, Celebes.	Nov. 16, 1909	R. C. Andrews.	112.5	71.5	47	16.8
Am. Mus. N. H. 110956.	...do....	Bass Island, Boni Gulf, Celebes.	Dec. 17, 1909	.....do.........	111	69.5	45.2	16.5
U.S.N.M. 145161.	[Female].	Celebes..................	....	G. Fischer.....	111.5	69.5	42.5	16.5
U.S.N.M. 145160.	...do....	.....do................	....	...do...........	111	69	41.5	17
A. N. S. Phila. 50142.	Female.	Menado, Celebes......	Oct. —, 1895	C. Hose........	108	69	42	16
U.S.N.M. 249732.	...do....	Toemaratas, Celebes..	July 3, 1916	H. C. Raven...	102.5	63	42	15
U.S.N.M. 249203.	...do....	Likoepang, Celebes...	Feb. 23, 1916	.....do.........	102	62	43	16.5
U.S.N.M. 249206.	...do....	.....do................	Feb. 29, 1916	.....do.........	104	65	38.5	14
U.S.N.M. 249207.	...do....	.....do................	.....do.......	.....do.........	104.5	62	43	15
U.S.N.M. 249208.	...do....	.....do................	Mar. 11, 1916	.....do.........	108.5	70	43	15

SAUROPATIS CHLORIS MEYERI (Sharpe).

Halcyon humii subsp. *a. meyeri* SHARPE, Cat. Birds Brit. Mus., vol. 17, 1892, p. 282 (Togian Islands, near Celebes).

Subspecific characters.—Resembling *Sauropatis chloris forsteni*, but apparently somewhat smaller; male with sides of body strongly suffused with buff; and auriculars more blackish (less greenish or bluish).

Measurements.—Both sexes:[1] Wing, 103–106 (average, 104.5) mm.; tail, 66.5–75 (69.8); (total) culmen, 54; tarsus, 15.

Type locality.—Togian Islands, Gulf of Tomini, northeastern Celebes.

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[1] Measured by Sharpe and Meyer and Wiglesworth

Geographic distribution.—Togian Islands.

Remarks.—No examples of this supposed race have been available in the present connection; but, if the types represent the adult male, the tinge of buffy on the sides of the body would seem to indicate a subspecific difference from the Celebesian *Sauropatis chloris forsteni.* The form is here provisionally recognized, pending further investigation with sufficient material from the Togian Islands.

SAUROPATIS CHLORIS ENIGMA (Hartert).

Halcyon enigma HARTERT, Novit. Zool., vol. 11, No. 1, March 25, 1904, p. 199. (Salibabu [Lirung] Island, Talaut Islands.)

Subspecific characters.—Similar to *Sauropatis chloris forsteni*, but averaging smaller.

Measurements.—Male:[1] Wing, 93.3 mm.; tail, 58; exposed culmen, 39.8; tarsus, 13.2.

Both sexes:[2] Wing, 90–104 mm.; tail, 54–65; culmen, 30–40, tarsus, 13 mm.

Type locality.—Salibabu Island, Talaut Islands (north of Celebes).

Geographic distribution.—Talaut Islands.

Remarks.—While I have not been able to examine many specimens of this form, it seems to me a somewhat unsatisfactory race, possibly not sufficiently distinct from *Sauropatis chloris forsteni* to retain a separate name. Size is apparently the only character, and the difference in this is not by any means so trenchant as Doctor Hartert supposed when describing his *Halcyon enigma*, for the measurements given by Meyer and Wiglesworth[3] show complete intergradation between the so-called small and large forms on the Talaut Islands. Furthermore, specimens of *Sauropatis chloris forsteni* from Celebes not infrequently have a wing measurement of as little as 102 mm., occasionally 100 mm., and other races of *Sauropatis chloris* are still smaller. It seems certain, therefore, that *Sauropatis enigma* is at most but a subspecies of *Sauropatis chloris.* It is possible, of course, as Doctor Hartert suggests,[4] that while *Sauropatis chloris enigma* is the breeding form on the Talaut Islands, the larger birds are only migratory visitants; but it seems probable that all the races of *Sauropatis chloris* are strictly resident. The most reasonable hypothesis to account for this unusually puzzling case appears to be that all the birds on the Talaut Islands belong to *Sauropatis chloris enigma*, although this would allow an astoundingly great range of individual variation in dimensions.

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[1] One specimen, No. 13825, J. H. Fleming; Karkellang Island, Talaut Islands, autumn, 1896.

[2] Ten specimens, measured by Hartert and Meyer and Wiglesworth.

[3] Birds Celebes, vol. 1, 1897, p. 294.

[4] Novit. Zool., vol. 11, No. 1, Mar. 25, 1904, p. 199.

SAUROPATIS CHLORIS COLLARIS (Scopoli).

Alcedo collaris Scopoli, Del Flor. et Faun. Insubr., pt. 2, 1786, p. 90 (Philippine Islands; based on *Le Martin Pêcheur a collier blanc des Philippines*, Sonnerat, Voyage Nouv. Guin., 1776, p. 67, pl. 33).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but averaging smaller; upper surface of male more greenish, rather brighter, lighter, less inclined to brownish; blackish nuchal collar narrower or obsolete; and exposed surface of wing-quills more greenish blue, and thus less contrasted with the interscapulum; auriculars usually green; female with upper parts more greenish (less bluish); blackish nuchal band narrower, more overlaid with greenish, and thus less conspicuous; wings more greenish (less bluish); and auriculars more greenish (less blackish).

Measurements.—Male: Total length (in flesh),[1] 248–256 mm.; extent,[1] 388–400; wing,[2] 102–110 (average, 106) mm.; tail, 63–72 (67.4); exposed culmen, 41–48 (44.2); tarsus, 15–17.5 (16).[2]

Female:[3] Wing, 98.5–112.5 (average, 106.2) mm.; tail, 62–74 (67.9); exposed culmen, 41–45.5 (43.2); tarsus, 15.2–17 (16.1).

Both sexes:[4] Wing, 98.5–112.5 (average, 106.1) mm.; tail, 62–74 (67.6); exposed culmen, 41–48 (43.8); tarsus, 15–17.5 (16).

Type locality.—Manila, Luzon Island, Philippine Islands.[5]

Geographic distribution.—Philippine Islands, north to the Batan Islands, west to the islands of Luzon, Mindoro, Calamianes, and Palawan; south to the islands of Palawan, Cagayan Sulu, Bongao, Tawi Tawi, and Mindanao; east to Mindanao Island, Samar Island, and the island of Luzon.

Remarks.—This is a well-differentiated race, particularly as compared with *Sauropatis chloris chloris*. Doctor Hartert's statement[6] that the ear-coverts in this form are nearly always greenish like the crown, hardly ever blackish, is borne out by the *males* of our large series, since in a large majority of the specimens of this sex now available the auriculars are at most only slightly, and that posteriorly, blackish. The narrower, sometimes even obsolete black nuchal band is also an excellent character.

From *Sauropatis chloris forsteni* this subspecies is distinguishable by its longer bill; and, in the male, by reason of its more greenish (less blackish) auriculars, less conspicuous, more greenish (less blackish) nuchal band, and rather lighter upper surface; in the female by reason of somewhat lighter, less olivaceous (more greenish) upper parts, narrower and more greenish dark nuchal band, more greenish ear-coverts, and more buffy-washed sides and flanks.

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[1] Two specimens.

[2] Twenty-eight specimens, from the Philippine Islands.

[3] Eighteen specimens, from the Philippine Islands.

[4] Forty-six specimens, from the Philippine Islands.

[5] Here first definitely restricted.

[6] Novit. Zool., vol. 11, No. 1, Mar. 25, 1904, p. 198.

The female of *Sauropatis chloris collaris* differs but slightly from the male, though it has usually somewhat duller, more olivaceous upper parts, a well-marked blackish nuchal band, and more blackish (less greenish) auriculars.

A large series of specimens from various parts of the range of this subspecies indicates that there is little if any geographic variation within these limits, since birds from the islands of Mindoro, Luzon, and Mindanao are, so far as we can see, identical in color. That any difference in dimensions is wholly negligible the following comparison of average measurements demonstrates:

Localities.	Wing.	Tail.	Exposed culmen.	Tarsus.
	mm.	*mm.*	*mm.*	*mm.*
Ten males from Luzon Island	106.1	66.9	44.0	15.9
Ten males, from Mindanao Island	106.3	67.7	44.3	16.2
Eight males, from Mindoro Island	105.4	67.8	44.4	15.9
Ten females, from Luzon Island	105.6	67.6	42.5	16.0
Six females, from Mindanao Island	106.2	68	43.8	16.2

The colors of the soft parts, as given on the labels of specimens examined, are as follows: Iris grayish brown; bill plumbeous black, broadly flesh color at base of mandible; feet purplish gray, the soles yellowish.

Some idea of the breeding season may be obtained from the note on one of the labels that a well-formed egg was found in the oviduct of a bird collected on March 23. One bird in molt was taken on January 18.

The proper subspecific name for the present race is undoubtedly *Sauropatis chloris collaris*,[1] as above indicated, since both *Alcedo chloris* Boddaert[2] and *Alcedo chlorocephala* Gmelin[3] apply certainly to the form from the Molucca Islands.

One hundred and seventy-two specimens of this race have been examined, from the following localities in the Philippine Archipelago:

Baluk Baluk Island.

Basilan Island.

Batan Island.—Santo Domingo de Basco.

Bongao Island.

Cebu Island.

Cuyo Island.

Fuga Island.

Lapac Island.

Luzon Island.—Pansipit River; Taal Volcano; Currimao (Ilocos Norte); Sorsogon; Tayabas; Infanta; Camarines; Cañacao (Cavite); Neuva Caceres; Cavite; San Fernando de Union; Port Binang; Corregidor Island in Manila Bay.

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[1] *Alcedo collaris* Scopoli, Del. Flor. et Faunn Insubr., pt. 2, 1876, p. 90.

[2] Tabl. Planch. Enlum., 1783, p. 49.

[3] Syst. Nat., vol. 1, pt. 1, 1788, p. 454.

Masbate Island.—Dumurug Point.

Mindanao Island.—Rio San Roque; Pantar; 10 miles north of Ayala; San Ramon Farm; Zamboanga; Tagulaya; Baganga; Panabatan Bay; Glan; Davao.

Mindoro Island.—Pola.

Palawan Island.

Palmas Island.

Panay Island.—Concepcion.

Samar Island.—Lanang.

Sibutu Island.—Three islets off the coast of Sibutu Island.

Sulu Island.—Hacienda of Panglima Hassan.

Measurements of 46 of these examples are given in the subjoined table:

Measurements of specimens of Sauropatis chloris collaris.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
Am. Mus. N. H. 93790	Male....	Infanta, Luzon Island, Philippine Islands.	Apr. 28, 1904	F. H. Porter...	106.5	64.5	47	16
Am. Mus. N. H. 93758	...do.....	Tayabas, Luzon Island, Philippine Islands.	Mar. 12, 1904	.....do..........	106.5	66.5	43	16
Am. Mus. N. H. 93801	...do.....	.....do.................	Mar. 17, 1904	.....do..........	110	69.5	42	16
Am. Mus. N. H. 93833	...do.....	Sorsogon, Luzon Island, Philippine Islands.	Jan. 14, 1903	.....do..........	102	66	42.5	16
Am. Mus. N. H. 93828	...do.....	.....do.................	Feb. 13, 1903	.....do..........	107.5	70.5	41.2	16.5
Am. Mus. N. H. 93827	...do.....	.....do.................	Feb. 21, 1903	.....do..........	105.5	65.5	44.5	16
Am. Mus. N. H. 93830	...do.....	.....do.................	Feb. 24, 1903	.....do..........	106.5	67	43.5	16
Am. Mus. N. H. 93807	...do.....	.....do.................	Mar. 4, 1903	.....do..........	108	68	45	16.2
Am. Mus. N. H. 93810	...do.....	.....do.................	Mar. 12, 1903	.....do..........	106	68	46	15.5
Am. Mus. N. H. 93818	...do.....	.....do.................	Apr. 10, 1903	.....do..........	102.5	63	45	15
U.S.N.M. 200827	...do.....	San Ramon Farm, Mindanao Island, Philippine Islands.	Mar. 23, 1906	E. A. Mearns...	105	69	46.8	17
U.S.N.M. 190070	...do.....	Zamboanga, Mindanao Island, Philippine Islands.	Oct. 14, 1903	.....do..........	102	66	42	17.5
U.S.N.M. 190194	...do.....	Pantar, Mindanao Island, Philippine Islands.	Aug. 30, 1903	.....do..........	105	67	43	15
U.S.N.M. 161227	...do.....	Mindanao Island, Philippine Islands.	Nov. 2, 1887	D.C. Worcester.	108	69	42.5	16
U.S.N.M. 192296	...do.....	Tagolaya, Mindanao Island, Philippine Islands.	July 14, 1904	E. A. Mearns...	109	67.5	47	17
U.S.N.M. 190602	...do.....	Baganga, Mindanao Island, Philippine Islands.	Oct. 22, 1903	.....do..........	108	68.5	42.5	16.2
U.S.N.M. 191987	...do.....	Zamboanga, Mindanao Island, Philippine Islands.	Jan. 18, 1904	.....do..........	106	65	45.5	15.5
U.S.N.M. 191988	...do.....	.....do.................	Jan. 24, 1904	.....do..........	106	66.5	44.5	16
U.S.N.M. 191986	...do.....	.....do.................	Jan. 13, 1904	.....do..........	105	66	44	15.5

Measurements of specimens of Sauropatis chloris collaris—Continued.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
U.S.N.M. 211377	Male....	Panabatan Bay, Mindanao Island, Philippine Islands.	Feb. 5, 1908	P. Bartsch.....	109	72	45.2	16
U.S.N.M. 161229	...do....	Mindoro Island, Philippine Islands.	May 5, 1888	F. S. Bourns...	107	72	43	16
Am.Mus. N.H. 93856	...do....	Pola, Mindoro Island, Philippine Islands.	Oct. 23, 1903	E. H. Porter...	102.5	65.5	43.5	15
Am.Mus. N.H. 93859	...do....	.....do...............	Nov. 3, 1903	.....do.........	109.5	69.5	46.5	16.2
Am.Mus. N.H. 93860	...do....	.....do...............	Nov. 4, 1903	.....do.........	104.5	67	46.5	15.5
Am.Mus. N.H. 93863	...do....	.....do...............	.....do.......	.....do.........	104	65	41	15.5
Am.Mus. N.H. 93862	...do....	.....do...............	.....do.......	.....do.........	107	69	46	16.5
Am.Mus. N.H. 93861	...do....	.....do...............	.....do.......	.....do.........	106	68	48	16.8
Am.Mus. N.H. 93864	...do....	.....do...............	Nov. 5, 1903	.....do.........	103	66.5	40.5	15.5
Am.Mus. N.H. 93831	Female .	Sorsogon, Luzon Island, Philippine Islands.	Feb. 11, 1903	.....do.........	109	71	42.5	15.5
Am.Mus. N.H. 93832	...do....	.....do...............	.....do.......	.....do.........	101	63.2	42.2	16.8
Am.Mus. N.H. 93824	...do....	.....do...............	Mar. —, 1903	.....do.........	106	66.5	42	16
Am.Mus. N.H. 93826	...do....	.....do...............	Mar. 1, 1903	.....do.........	108.2	69	42	16.2
Am.Mus. N.H. 93815	...do....	.....do...............	Mar. 9, 1903	.....do.........	106.5	68.5	41	16.2
Am.Mus. N.H. 93837	...do....	.....do...............	May 25, 1903	.....do.........	106.5	68	44	16.2
Am.Mus. N.H. 93796	...do....	Infanta, Luzon Island, Philippine Islands.	Apr. 13, 1904	.....do.........	106	67	43.5	16
Am.Mus. N.H. 93788	...do....	Camarines, Luzon Island, Philippine Islands.	Dec. 12, 1902	.....do.........	106.5	67.5	44	16
Am.Mus. N.H. 93783	...do....	Tayabas, Luzon Island, Philippine Islands.	Dec. 12, 1903	.....do.........	98.5	65	43	16
Am.Mus. N.H. 93784	...do....	.....do...............	Dec. 26, 1903	.....do.........	107.5	70	41	15.2
U.S.N.M. 161228	...do....	Mindanao Island, Philippine Islands.	Nov. 2, 1887	....	112.5	74	43	15.5
U.S.N.M. 191990	...do....	Zamboanga, Mindanao Island, Philippine Islands.	Mar. 19, 1904	E. A. Mearns..	107	68	43.5	17
U.S.N.M. 191989	...do....	.....do...............	.....do.......	.....do.........	107	68	45.5	17
U.S.N.M. 190604	...do....	Glan, Mindanao Island, Philippine Islands.	Oct. 26, 1903	.....do.........	102	62	43	16
U.S.N.M. 211378	...do....	Davao, Mindanao Island, Philippine Islands.	May 17, 1908	P. Bartsch.....	102	66	43.5	15.8
U.S.N.M. 200826	...do....	San Ramon Farm, Mindanao Island, Philippine Islands.	Mar. 23, 1906	E. A. Mearns..	106.5	70	44.5	15.8
U.S.N.M. 161230	...do....	Cebu Island, Philippine Islands.	Mar. 21, 1888	D.C. Worcester.	108	69	44.5	16
U.S.N.M. 161225	...do....	Panay Island, Philippine Islands.	Jan. 18, 1888	F. S. Bourns...	110	69.5	44.5	17

SAUROPATIS CHLORIS CYANESCENS Oberholser.

Sauropatis chloris cyanescens OBERHOLSER, Proc. U. S. Nat. Mus., vol. 52, February 8, 1917, p. 189 (Pulo Taya, off the southeastern coast of Sumatra).

Subspecific characters.—Similar to *Sauropatis chloris collaris*, but bill much larger; other dimensions averaging slightly greater; male with upper parts decidedly more bluish; blackish nuchal band wider, conspicuous, and less overlaid with greenish; and auriculars somewhat more blackish (less greenish); female with upper surface darker, more olive brownish; blackish nuchal band wider; auriculars more blackish; sides and flanks less washed with buffy, generally not at all.

Description.—Type, adult male, No. 170835, U.S.N.M.; Pulo Taya, off the southeastern coast of Sumatra, July 28, 1899; Dr. W. L. Abbott. Pileum dull sea green; back and scapulars dark beryl green; a large, almost concealed patch of white on the occiput; a narrow blackish nuchal band; a broad white cervical collar; lower back, rump, and upper tail-coverts bluish beryl green; wings fuscous, the greater wing-coverts and most of the exposed portion of the wing-quills somewhat purplish Paris blue; the remainder of the wing-coverts, the tertials and distal portions of exposed surface of wing-quills, excepting the fuscous tips, greenish Antwerp blue, the bend of the wing decidedly greenish; tail greenish Antwerp blue; lores black; supraloral spot creamy white; a narrow line over the eye and a spot on lower eyelid white; remainder of sides of head dull beryl green, darker on the cheeks, the posterior auriculars blackish; entire lower surface white.

Measurements.—Male[1]: Wing, 102–113 (average, 108) mm.; tail, 64.5–74 (69.2); exposed culmen, 41.5–53.5 (47.2); tarsus, 15–18.5 (16.4).

Female[2]: Wing, 98.5–115 (average, 108.3) mm.; tail, 65–76 (70.3); exposed culmen, 43–51 (47.3); tarsus, 15–18 (16.6).

Both sexes[3]: Wing, 98.5–115 (average, 108.1); tail, 64.5–76 (69.8); exposed culmen, 41.5–53.5 (47.3); tarsus, 15–18.5 (16.5).

Type locality.—Pulo Taya, Berhala Strait, off the southeastern coast of Sumatra.

Geographic distribution.—East India Islands, north to Borneo, the Natuna Islands, Anamba Islands, Pulo Taya (Berhala Strait), Pulo Parit (near Karimon Island), and northeastern Sumatra; west to northeastern Sumatra; south to Sumatra (excepting the northwestern cost), Banka Island, Bawean Island, Solombo Besar Island,

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[1] Thirty-nine specimens, from Borneo, Sumatra, and neighboring islands.

[2] Thirty-eight specimens, from Borneo, Sumatra, and neighboring islands.

[3] Seventy-eight specimens, from Borneo, Sumatra, and neighboring islands.

and the Laurot Islands; and east to eastern Borneo with the small islands along its eastern coast.

Remarks.—This recently described subspecies may be distinguished from *Sauropatis chloris forsteni* by its much longer bill; and, in the male, by decidedly more bluish upper surface, and more greenish (less blackish) ear-coverts. The females of these two forms appear to be scarcely different in color. Compared with *Sauropatis chloris chloris* this has a longer bill; in the male the upper surface is rather more bluish, there being thus less contrast between the back and wings; the ear-coverts are more greenish (less blackish); and the blackish nuchal band narrower, more overlaid with green, and thus less distinct; in the female the upper surface averages darker; the wings are somewhat more bluish; the ear-coverts more greenish, and the blackish nuchal band usually more washed with greenish.

The female of this race is commonly very different from the male in her duller, more olive green upper parts, more blackish auriculars, and broader black nuchal band.

The juvenal plumage is somewhat similar to that of the adult, but the pileum is dull brown with posteriorly a wash of bluish green, the feathers of the forehead with a few narrow creamy or buffy edgings; blackish nuchal band more brownish; white feathers of the cervical collar with dark brown or blackish tips; back duller, darker, and more brownish; wings and tail duller, less bluish; sides of head duller, more brownish, the cheeks and auriculars brownish black, only the former with a slight greenish wash; breast and abdomen somewhat tinged with buff; breast, sides of throat and of body heavily barred or marked with scale-like feather tips of fuscous; and there is also a small blackish brown patch on each side of the breast. The above description is taken chiefly from two juvenal birds, a male, No. 182397, U.S.N.M., collected on Pulo Bilang Bilangan, off eastern Borneo, June 1, 1913; and a female, No. 181897, U.S.N.M., from Pulo Raboe Raboe, July 27, 1912, which dates give some idea of the breeding season.

Birds from the islands along the eastern coast of Borneo appear to be identical with those from eastern Sumatra, as far north as Laboean, Deli. In fact, there seems to be no essential geographic color difference among specimens from the Natuna Islands, Anamba Islands, Tambelan Islands, Bawean Island, Borneo with its coastal islands, Banka, and eastern Sumatra.

Specimens from various parts of the range of this subspecies exhibit the following average measurements, in which most of the variations are due to the small series from many of the localities:

Localities.	Wing.	Tail.	Exposed culmen.	Tarsus.
	mm.	*mm.*	*mm.*	*mm.*
Two males, from the Anamba Islands	110.0	67.0	44.3	16.3
One male, from the island of Banka	110.0	66.0	46.0	18.5
One male, from Pulo Taya	110.5	72.5	46.0	17.0
One male, from Bawean Island, Java Sea	111.3	71.5	42.0	16.5
Two males, from Sumatra	106.5	65.8	44.5	16.0
Two males, from Pulo Maura Tua, eastern Borneo	106.5	68.3	47.3	16.8
Two males, from Pulo Balik Kukup, eastern Borneo	108.3	70.8	49.0	16.5
Three males, from Pulo Sangalan, eastern Borneo	108.8	71.5	47.2	16.5
Three males, from Pulo Raboe Raboe, eastern Borneo	105.0	67.5	46.7	16.2
Three males, from Pulo Samama, eastern Borneo	105.2	69.2	46.0	16.2
Four males, from Pulo Derawan, eastern Borneo	108.3	70.0	50.4	16.9
Five males, from Pulo Bilang Bilangan, eastern Borneo	109.0	68.9	50.1	16.5
Three females, from the Natuna Islands	109.3	72.2	48.8	17.2
Two females, from the island of Banka	106.3	69.0	44.4	15.8
Three females, from Pulo Taya	113.2	72.2	47.7	17.3
Four females, from Sumatra	106.6	68.0	47.4	16.5
Two females, from Bawean Island, Java Sea	112.7	71.0	47.4	17.2
Two females, from Pulo Sanga Laki, eastern Borneo	108.0	72.3	47.3	16.8
Three females, from Pulo Balik Kukup, eastern Borneo	108.7	70.5	47.7	16.2
Two females, from Pulo Mataha, eastern Borneo	100.3	69.0	46.7	16.7
Three females, from Pulo Raboe Raboe, eastern Borneo	104.8	69.0	45.3	16.8
Five females, from Pulo Derawan, eastern Borneo	109.2	70.1	47.5	16.9
Two females, from Pulo Bilang Bilangan, eastern Borneo	108.3	69.3	48.4	16.8

The colors of the soft parts, as given on specimen labels, are: Iris bluish gray, dark brown or light brown; bill black, the basal portion of mandible white or creamy white; feet gray, bluish black or dark brown, the soles pale, the claws black.

Measurements of practically all the adults examined are included in the following table:

Measurements of specimens of Sauropatis chloris cyanescens.

Museum and number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 171022	Male...	Pulo Mata, Anamba Islands.	Aug. 28, 1899	Dr. W. L. Abbott.	254	110.5	70	43	17.5
U.S.N.M. 170994	...do....	Islet near Pulo Mobur, Anamba Islands.	Aug. 26, 1899	.....do.......	248	111.5	68	47	15.5
U.S.N.M. 170886	...do....	Pulo Wai, Tambelan Islands.	Aug. 13, 1899	.....do.......	254	110.5	70	43	17.5
U.S.N.M. 180517	...do....	Tanjong Rengsan, Banka Island.	May 20, 1904	.....do.......	250	110	66	46	18.5
U.S.N.M. 170835	[Male]..	Pulo Taya, off coast of southeastern Sumatra.[b]	July 28, 1899	.....do.......	260.5	110.5	72.5	46	17
U.S.N.M. 180195	...do....	Pulo Parit, near Karimon Island, southeastern Sumatra.	June 11, 1903	.....do.......	250	110	68	47.5	16.5
A.N.S.Phila 38928	...do....	Batu Sangkar, Tavah Datar, Padang, Bovenland, Sumatra.	Aug.-Sept., 1901.	A. C. Harrison, jr. and H. M. Miller.	....	111	67	45	16
A.N.S.Phila 56164	Male...	Padang Pandjang, Sumatra.	Jan. 15, 1897	J. Z. Kannegieter.	....	102	64.5	44	16
U.S.N.M. 181492	...do....	Pulo Solombo Besar, Java Sea.	Dec. 4, 1907	Dr. W. L. Abbott.	263	110	71.5	48	16
U.S.N.M. 181495	...do....	Bawean Island, Java Sea.	Nov. 20, 1907	.....do.......	254	111.3	71.5	42	16.5
Am. Mus. N.H. 110954	...do....	Tawao, British North Borneo.	Jan. 2, 1910	R. C. Andrews.	....	104	69	44.5	15
U.S.N.M. 181011	...do....	Pulo Temaju, western Borneo.	June 9, 1905	Dr. W. L. Abbott.	260	113	70	48	16.5

[a] Measured in the flesh by the collector.

[b] Type.

***Measurements of specimens of Sauropatis chloris cyanescens*—Continued.**

Museum and number.	Sex.	Locality.	Date.	Collector.	Total length.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 181490	Male...	Pulo Laut, southeastern Borneo.	Dec. 23, 1907	Dr. W. L. Abbott.	....	109	69.5	46.5	16
U.S.N.M. 182411	...do....	Pulo Sanga Laki, eastern Borneo.	May 26, 1913	H. C. Raven	....	105	72.5	47	16
U.S.N.M. 182386	...do....	Pulo Maura Tua, eastern Borneo.	May 20, 1913	.....do.......	....	109	71.5	48	16.5
U.SN.M. 182387	...do....	.....do..........	.....do.......	.....do.......	....	104	65	46.5	17
U.S.N.M. 182401	...do....	Pulo Balik Kukup, eastern Borneo.	June 9, 1913	.....do.......	....	109	71.5	50.5	16.5
U.S.N.M. 182405	...do....	.....do..........	June 10, 1913	.....do.......	....	107.5	70	47.5	16.5
U.S.N.M. 182406	...do....	Pulo Lusa Kukup, eastern Borneo.	May 15, 1913	.....do.......	....	107	68.5	48.5	17.5
U.S.N.M. 182415	...do....	Pulo Sangalan, eastern Borneo.	May 13, 1913	.....do.......	....	111	74	48	16
U.S.N.M. 182416	...do....	.....do..........	.....do.......	.....do.......	....	107	68.5	46	16.5
U.S.N.M. 182417	...do....	.....do..........	.....do.......	.....do.......	....	108.5	72	47.5	17
U.S.N.M. 182408	...do....	Pulo Mataha, eastern Borneo.	June 5, 1913	.....do.......	....	108	69.5	48.5	16
U.S.N.M. 182384	...do....	Pulo Raboe Raboe, eastern Borneo.	May 4, 1913	.....do.......	....	102	67.5	45	15.5
U.S.N.M. 182385	...do....	.....do..........	.....do.......	.....do.......	....	108	69	46	16
U.S.N.M. 181896	...do....	.....do..........	July 27, 1912	.....do.......	....	105	66	49	17
U.S.N.M. 182392	...do....	Pulo Samama, eastern Borneo.	Apr. 21, 1913	.....do.......	....	104	67.5	44.5	16
U.S.N.M. 182391	...do....	.....do..........	.....do.......	.....do.......	....	103	70	45	16.5
U.S.N.M. 182390	...do....	.....do..........	.....do.......	.....do.......	....	108.5	70	48.5	16
U.S.N.M. 182413	...do....	Pulo Bakungan, eastern Borneo.	May 17, 1913	.....do.......	....	107.5	70	45.5	15.5
U.S.N.M. 181888	...do....	Pulo Derawan, eastern Borneo.	July 22, 1912	.....do.......	....	111	69.5	50.5	17.5
U.S.N.M. 181886	...do....	.....do..........	.....do.......	.....do.......	....	108.5	71	50.5	16.5
U.S.N.M. 181890	...do....	.....do..........	July 23, 1912	.....do.......	....	105.5	68.5	50.5	16.5
U.S.N.M. 181891	...do....	.....do..........	.....do.......	.....do.......	....	108	71	50	17
U.S.N.M. 182393	...do....	Pulo Bilang Bilangan, eastern Borneo.	May 30, 1913	.....do.......	....	110.5	71	50.5	16
U.S.N.M. 182394	...do....	.....do..........	May 31, 1913	.....do.......	....	107	68.5	53.5	16.3
U.S.N.M. 182398	...do....	.....do..........	June 1, 1913	.....do.......	....	109	66.5	49	16
U.S.N.M. 182399	..do....	.....do..........	.....do.......	.....do.......	....	110.5	70.5	50	16.5
U.S.N.M. 182400	...do....	.....do..........	June 3, 1913	.....do.......	....	108	68	47.5	.8
U.S.N.M. 174698	Female	Pulo Subi, north islet, Natuna Islands.	June 12, 1900	Dr. W. L. Abbott.	248	108.5	69.5	45.5	17
U.S.N.M. 174697	...do....	Sirhassen Island, Natuna Islands.	June 10, 1900	.....do.......	260.5	112.5	74.5	50	18
U.S.N.M. 174696	...do....	Bunguran Island, Natuna Islands.	July 7, 1900	.....do.......	266.5	107	72.5	51	16
U.S.N.M. 180519	...do....	Telok Edar, Karimata Island, western Borneo.	Sept. 4, 1904	.....do.......	265	113	76	48	16
U.S.N.M. 180518	...do....	Tanjong Rengsan, Banka Island.	May 21, 1904	.....do.......	255	112	71.5	44.5	16
A. N. S. Phila. 56165	...do....	Soenge Lujat, Banka Island.	Apr. 13 to July 11, 1898	J. Z. Kannegieter.	....	100.5	66.5	44.2	15
U.S.N.M. 170834	...do....	Pulo Taya, off coast of southeastern Sumatra.	July 28, 1899	Dr. W. L. Abbott.	260.5	111.5	70	46	17
U.S.N.M. 170836	...do....	.....do..........	.....do.......	.....do.......	270	113	72	48	17.5
U.S.N.M. 170833	...do....	.....do..........	July 27, 1899	.....do.......	273	115	74.5	49	17.5

Measurements of specimens of Sauropatis chloris cyanescens—Continued.

Museum and number.	Sex.	Locality	Date.	Collector.	Total length.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
A. N. S. Phila. 38926	[Female]	Batu Sangkar, Tavah Datar, Padang, Bovenland, Sumatra.	Aug.-Sept., 1901	A. C. Harrison, jr., and H. M. Miller.	....	110	72	48	16
A. N. S. Phila. 38930	...do....	.....do.............	.....do.......	.....do.......	....	112	67	49	16
A. N. S. Phila. 38929	...do....	.....do.............	.....do.......	.....do.......	....	101	66	47.5	18
A. N. S. Phila. 38927	...do....	.....do.............	.....do.......	.....do.......	....	103.5	67	45	16
U.S.N.M. 181491	Female, im.	Pulo Mata Siri, Java Sea.	Dec. 12, 1907	Dr. W. L. Abbott.	258	112	70	46	15.5
U.S.N.M. 181493	Female	Bawean Island, Java Sea.	Nov. 19, 1907	.....do.......	262	110.8	73	46.5	17
U.S.N.M. 181494	...do....	.....do.............	Nov. 20, 1907	.....do.......	265	114.5	69	48.3	17.3
A. N. S. Phila. 50140	...do....	Indrulaman, Borneo	Oct. —, 1895	A. Everett..	....	102	65	43	15.5
U.S.N.M. 182410	...do....	Pulo Sanga Laki, eastern Borneo.	May 26, 1913	H. C. Raven	....	108.5	74	44	16
U.S.N.M. 182412	...do....	.....do.............	May 27, 1913	.....do.......	....	107.5	70.5	50.5	17.5
U.S.N.M. 182388	...do....	Pulo Maura Tua, eastern Borneo.	May 24, 1913	.....do.......	....	108	72.5	51	16.5
U.S.N.M. 182403	...do....	Pulo Balik Kukup, eastern Borneo.	June 9, 1913	.....do.......	....	109	70.5	45	16
U.S.N.M. 182402	...do....	.....do.............	.....do.......	.....do.......	....	108	70.5	48	16.5
U.S.N.M. 182404	...do....	.....do.............	June 10, 1913	.....do.......	....	109	70.5	50	16
U.S.N.M. 182407	...do....	Pulo Mataha, eastern Borneo.	June 5, 1913	.....do.......	....	98.5	66.5	48	16.5
U.S.N.M. 182409	...do....	.....do.............	.....do.......	.....do.......	....	102	71.5	45.3	16.8
U.S.N.M. 182381	...do....	Pulo Raboe Raboe, eastern Borneo.	May 4, 1913	.....do.......	....	109.5	71.5	50	17.5
U.S.N.M. 182383	...do....	.....do.............	.....do.......	.....do.......	....	100	66.5	43	16
U.S.N.M. 182382	...do....	.....do.............	.....do.......	.....do.......	....	105	69	43	17
U.S.N.M. 182389	...do....	Pulo Samama, eastern Borneo.	Apr. 21, 1913	.....do.......	....	107	68	48	16.5
U.S.N.M. 182418	...do....	Pulo Alanga, eastern Borneo.	May 12, 1913	.....do.......	....	111	71.5	48.5	17
U.S.N.M. 182414	...do....	Pulo Bakungan, eastern Borneo.	May 17, 1913	.....do.......	....	114	74.5	51	16
U.S.N.M. 181887	...do....	Pulo Derawan, eastern Borneo.	July 22, 1912	.....do.......	....	110	68	48.5	17
U.S.N.M. 181889	...do....	.....do.............	July 23, 1912	.....do.......	....	110	69.5	49	17
U.S.N.M. 181893	...do....	.....do.............	.....do.......	.....do.......	....	109.5	70	48.5	17
U.S.N.M. 181894	...do....	.....do.............	.....do.......	.....do.......	....	108	71.5	48.5	17
U.S.N.M. 181892	...do....	.....do.............	.....do.......	.....do.......	....	108.5	71.5	43	16.5
U.S.N.M. 182395	...do....	Pulo Bilang Bilangan, eastern Borneo.	June 1, 1913	.....do.......	....	108.5	70	48	16
U.S.N.M. 182396	...do....	.....do.............	.....do.......	.....do.......	....	108	68.5	48.8	17.5
U.S.N.M. 181895	....	Pulo Derawan, eastern Borneo.	July 23, 1912	.....do.......	....	105	71	50	16.5

SAUROPATIS CHLORIS PALMERI, new subspecies.[1]

Subspecific characters.—Resembling *Sauropatis chloris cyanescens*, but bill slightly smaller; male averaging lighter and more bluish above, with a narrower and less distinct, sometimes obsolete, blackish nuchal band; and auriculars usually a little more greenish (less blackish) especially on posterior portion; female lighter, more bluish on upper surface; blackish nuchal band narrower and less distinct; and auriculars less solidly black (more greenish).

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[1] Named for Mr. William Palmer, who collected the type specimen.

Description.—Type, adult male, No. 218416, U.S.N.M.; Goenoeng Boender, Mount Salak, 2400 feet, Java, May 17, 1909; William Palmer. Pileum dull sea green; back and scapulars dark beryl green; a large, almost concealed patch of white on the occiput; no blackish nuchal band; a broad, white cervical collar; lower back, rump, and upper tail-coverts bluish beryl green; wings fuscous, the greater wing-coverts and most of the exposed portion of the wing-quills somewhat purplish Paris blue; the remainder of the wing-coverts, the tertials, and distal portion of exposed surface of wing-quills. excepting the fuscous tips, greenish Antwerp blue, the bend of the wing decidedly greenish; tail greenish Antwerp blue; lores black; supraloral spot creamy white; a narrow line over the eye and a spot on lower eyelid white; remainder of sides of head dull beryl green, darker on the cheeks, the posterior auriculars blackish; entire lower surface white, the sides of body slightly washed with buff.

Measurements.—Male[1]: wing, 105–111.5 (average, 107.2) mm.; tail, 63–71 (68.); exposed culmen, 43.5–50 (46.2); tarsus, 16–18 (16.6).

Female[2]: Wing, 103–114 (average, 109) mm.; tail, 66.5–73 (70.1); exposed culmen, 42.5–49 (45.6); tarsus, 15–17 (16.1).

Both sexes[3]; Wing, 103–114 (average, 108 mm.; tail, 63–73 (68.9); exposed culmen, 42.5–50 (45.9); tarsus, 15–18 (16.4).

Type locality.—Goenoeng Boender, Mount Salak, 2400 feet altitude, Java.

Geographic distribution.—Java.

Remarks.—This new race may be separated from *Sauropatis chloris forsteni* by its longer bill; in the male also by the much more bluish upper parts; practical obliteration of the blackish nuchal band; and mostly greenish ear-coverts; in the female by the same characters, though not so pronouncedly. From *Sauropatis chloris chloris* it may be differentiated in the male by the brighter, much more bluish upper surface; obsolescent or obsolete blackish nuchal band; and greenish or bluish auriculars; in the female by the usually more bluish upper parts; more greenish ear-coverts; less conspicuous, because narrower and more greenish-overlaid, blackish nuchal band. It may readily be distinguished from *Sauropatis chloris collaris* by its much more bluish upper parts, and somewhat longer bill.

In this race the female differs from the male in the duller, much more greenish or olivaceous (less bluish) superior surface; wider and more conspicuous blackish nuchal band; and more blackish (less greenish) ear-coverts.

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[1] Thirteen specimens, from Java.

[2] Twelve specimens, from Java.

[3] Twenty-five specimens, from Java.

Colors of the soft parts in this form, as given on the specimen labels by the collectors, are, in the adult: Iris brown or brownish black; bill black, the basal portion of mandible white; feet gray; and in the juvenal: Iris brownish black; bill black, the mandible, except its tip, gray; feet gray.

So far as we have been able to determine, *Sauropatis chloris palmeri* is confined to the island of Java, though it probably in due time will be found on some of the nearby smaller islands. Java has been designated as the type locality of *Sauropatis chloris chloris* by von Berlepsch[1], but, as already shown[2], quite erroneously. The Javan race has thus, therefore, hitherto remained without a subspecific name.

Measurements of the specimens examined are given below:

Measurements of specimens of Sauropatis chloris palmeri.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
U.S.N.M. 219380	Male	Depok, Java	July 30, 1909	W. Palmer	106.5	63	50	17.3
U.S.N.M. 219377	do	do	June 20, 1909	do	109	70	47.5	16
U.S.N.M. 218930	do	Buitenzorg, Java	Apr. 6, 1909	do	106	70	48	16.3
U.S.N.M. 218416	do	Goenoeng Boender, Mt. Salak, 2400 ft., Java.[a]	May 17, 1909	do	110.5	69.5	43.5	16.8
U.S.N.M. 219828	do	Pelaboean Ratoe, Java.	Oct. 8, 1909	do	109	66	45.2	16.8
U.S.N.M. 218928	do	Tjenkareng, Java	Mar. 3, 1909	do	107	68.5	46	16.5
U.S.N.M. 218413	do	Buitenzorg, Java	May 1, 1909	do	107	67.5	45	16
U.S.N.M. 219829 [b]	Male, im.	Keledjetan, Java	Nov. 22, 1909	do	......	......	......	.....
M. C. Z. 39685	[Male]	Wynkoops Bai, Java	....	J. V. Bemmelen	111.5	68.5	47.5	16
A. N. S. Phila. 21440	Male	Java	....	Rivoli collection	106	69	44	16.5
A. N. S. Phila. 21435	do	do	....	do	105	71	44.5	18
A. N. S. Phila. 56162	"Female" [=Male].	Palaboean Ratoe, Java	Oct. 8, 1898 to Jan. 31, 1899	J. Z. Kannegieter.	105	67	47	17
A. N. S. Phila. 56163	Male	do	do	do	105	67	45.8	17.2
A. N. S. Phila. 56156	Male, im.	Omstreken, Batavia, Java.	....	do	106	66.5	......	16
U.S.N.M. 219379	Female.	Depok, Java	July 18, 1909	W. Palmer	103	70	44	16
U.S.N.M. 218415	do	Goenoeng Boender, Mt. Salak, 2400 ft., Java.	May 16, 1909	do	110	70	43	16
U.S.N.M. 218929	do	Tandjoeng, Java	Feb. 5, 1909	do	113	71	49	17
U.S.N.M. 218931	do	Buitenzorg, Java	Apr. 6, 1909	do	104	......	47	17

[a] Type.
[b] Not used in measurement averages.

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[1] Abhandl. Senckenb. Naturf. Gesells., vol. 34, Heft 1, 1911, p. 75.

[2] See p. 356.

Measurements of specimens of Sauropatis chloris palmeri—Continued.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
U.S.N.M. 218412	Female.	Buitenzorg, Java......	May 1, 1909	W. Palmer.....	109	68	46.5	15.5
U.S.N.M. 219827	...do.....	Tjibodas, Mt. Oede, 4500 ft., Java.	Aug. 23, 1909	.....do..........	109.5	72	47	15.5
U.S.N.M. 218414	...do.....	Mt. Salak, 2000 ft., Java.	May 7, 1909	.....do..........	111.5	73	45.5	16.5
Am. Mus. N. H. 60290	"Male" [=Female]	Preanger Regent, western Java.	1892	....	114	70	49	16.5
A. N. S. Phila. 56160	Female.	Pandan Aroem, Preanger, western Java.	....	J. Z. Kannegieter.	106	66.5	45.5	16.3
A. N. S. Phila. 56157	...do.....	Omstreken, Batavia, Java.	....	.....do..........	110	68.5	45	15
A. N. S. Phila. 56158	...do.....	.....do................	....	.....do..........	111	72	42.5	15.5
A. N. S. Phila. 56161	Female, im.	Pelaboean, Tjibadja, Java.	Nov. 7-21, 1897.	.....do..........	106.5	70	43	16.8
A. N. S. Phila. 56159[a]	Female, juv.	Goenong Pantjar, Java	Oct. 14 to Nov. 5, 1897	.....do..........	......	......	......	.....

[a] Not used in measurement averages.

SAUROPATIS CHLORIS ARMSTRONGI (Sharpe).

Halcyon chloris subsp. *a. armstrongi* SHARPE, Cat. Birds Brit. Mus., vol. 17, 1892, p. 277, pl. 7, fig. 1 (Sunderbunds to Burmah, Tenasserim, and Siam).

Halcyon humii SHARPE, Cat. Birds Brit. Mus., vol. 17, 1892, p. 281, pl. 8 ("Siam to the Malayan Peninsula and Sumatra"; type locality as "accepted" by Dr. E. Hartert,[1] Mergui, Tenasserim; type in British Museum is from Jaram, Selangor, Malay Peninsula).

Subspecific characters.—Similar to *Sauropatis chloris cyanescens*, but very much smaller; upper parts of male, including wings, more bluish; ear-coverts usually more greenish or bluish; black nuchal band narrower, obsolete, or even absent, and when present always more or less washed with greenish or bluish; sides and flanks more conspicuously washed with buff; female with upper parts, particularly the pileum, averaging rather lighter; exposed edges of wing-quills more bluish (less greenish); blackish nuchal collar narrower.

Measurements.—Male[2]: Wing, 94–109 (average, 100.8) mm.; tail, 59–71.5 (64.7); exposed culmen, 38.5–43 (41.6); tarsus, 13–17 (15.5).

Female[3]: Wing, 95.5–104.5 (average, 99.9) mm.; tail, 64–69 (65.6); exposed culmen, 40.5–43 (41.3); tarsus, 15–16.5 (15.8).

Both sexes[4]: Wing, 94–109 (average, 100.4) mm.; tail, 59–71.5 (64.7); exposed culmen, 37.5–45.5 (41.6); tarsus, 13–17 (15.5).

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[1] Novit. Zool., vol. 9, No. 3, Dec. 16, 1902, p. 543. See, however, p. 374.

[2] Nine specimens, from Cochin China, Siam, Tenasserim, India, and the Malay Peninsula.

[3] Four specimens, from Lower Siam and the Malay Peninsula.

[4] Fifteen specimens, from Cochin China, Siam, Tenasserim, India, and the Malay Peninsula.

Type locality.—Siam.[1]

Geographic distribution.—Indo-Malayan region, north to southern Siam, coast region of Burmah, and the southeastern part of Bengal, India (Sunderbunds); west to the Sunderbunds, the western coast of the Malay Peninsula and its islands, including the Mergui Archipelago and Pulo Lankawi; south to the southern Malay Peninsula, the island of Singapore, and Cochin China; and east to the eastern coast of the Malay Peninsula and Cochin China.

Remarks.—This is a form undoubtedly worthy of recognition, though not a species as often regarded; it is one of the smallest subspecies of *Sauropatis chloris.* From *Sauropatis chloris palmeri* of Java, it differs by reason of its much reduced size, also, in the male, by usually more bluish upper parts, and, in the female, by its more *greenish* upper surface. It may be separated from *Sauropatis chloris collaris* by its much smaller size, much more bluish upper surface, and somewhat more evident black nuchal band in the male; and ordinarily darker, more greenish upper parts, with wider black nuchal band in the female. It may be distinguished from *Sauropatis chloris forsteni* by its smaller size, also, in the male, by its much more bluish upper parts, more greenish ear-coverts, and narrower, black nuchal band; in the female by the somewhat wider black nuchal band and more greenish auriculars. Compared with *Sauropatis chloris chloris* it is much smaller, with, in the male, the wings more bluish, the upper surface averaging darker, the black nuchal band much narrower or obsolescent, the ear-coverts more greenish, and the sides and flanks conspicuously buffy; and, in the female, the wings decidedly more bluish and more contrasted with the back, the upper parts averaging darker, the black nuchal band narrower, and the auriculars more greenish.

A single specimen marked "India" is larger than any other of our present series, but is otherwise not different. Birds from the Mergui Archipelago apparently do not differ from those found on the near-by Malay Peninsula.

Examples from Cochin China and Siam are, in both size and color, apparently identical with birds from the Malay Peninsula. I am, in fact, unable to find any satisfactory differences between specimens from various localities—Siam, Burmah, and the central and southern Malay Peninsula—to warrant at present any further racial subdivision. Thus I am not able to distinguish *Sauropatis humii*, even as a subspecies, since typical examples of both *Sauropatis chloris armstrongi* and so-called *humii* occur throughout the same regions, together with various intermediates which completely obliterate the significance of the characters assigned to separate the two forms. The theory that one form migrates into the territory of the other, besides being improbable, would help us little, for both *armstrongi* and "*humii*" occur in the north as well as in the south. The bird described as *Halcyon humii* by Doctor Sharpe[1] is supposed to be more uniformly bluish above than *Sauropatis chloris armstrongi*, and to lack the blackish nuchal band of the latter; but the evidence of intermediates points to the probably correct conclusion that this plumage represents the extreme development of the fully adult male *Sauropatis chloris armstrongi*, possibly even to be regarded as a blue phase, for all the males are by no means so bluish. The most greenish birds, however, are females, and although there is no absolute line of demarcation between the sexes, the females are usually duller, very much more greenish above, including the wings, with ear-coverts and nuchal band more blackish, and sides of body without buffy tinge. Although with this view of relationship, a wide range of color variation must be allowed in *Sauropatis chloris armstrongi*, it is not so very much greater than occurs in some of the other races. The most bluish old males of *Sauropatis chloris armstrongi* (="*humii*") are in this respect more highly colored than any unworn examples of *Sauropatis chloris cyanescens* that I have seen, but in some cases the difference is not great. The occurrence of *Sauropatis chloris armstrongi* in either Borneo or Sumatra is of course erroneous, and the specimens so recorded by Doctor Sharpe[2] belong to *Sauropatis chloris cyanescens*.

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[1] Type in British Museum.

The colors of the soft parts in this race as given on specimen labels are as follows: Iris dark brown or blackish brown; bill black, the base of mandible creamy white; feet pale plumbeous, plumbeous gray, dark plumbeous, or dark brown, the claws black.

The proper name for this subspecies is *Sauropatis chloris armstrongi;* for although Doctor Sharpe described his *Halcyon chloris* subsp. *α. armstrongi*[3] and *Halcyon humii*[4] in the same volume, the former has anteriority. The only indication of type locality given for *Sauropatis chloris armstrongi* is the statement that it occurs from the Sunderbunds to Burmah, Tenasserim, and Siam.[3] The type in the British Museum is, however, so Mr. Charles Chubb informs me,[5] one of the Gould collection from Siam.

Similarly, no more definite indication of type locality was given for Sharpe's *Halcyon humii*[6] than "Siam to the Malay Peninsula and Sumatra." Doctor Hartert subsequently designated Mergui, Tenasserim as the typical locality; but the type of this form is still in the

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[1] Cat. Birds Brit. Mus., vol. 17, 1892, p. 281 (Jaram, Selangor, Malay Peninsula).
[2] Idem, pp. 278, 283.
[3] Idem, p. 277, pl. 7, fig. 1.
[4] Idem, p. 281, pl. 8.
[5] In a letter.
[6] Cat. Birds Brit. Mus., vol. 17, 1892, p. 281.

British Museum, and is from Jaram, Selangor, Malay Peninsula; for which information I am further indebted to Mr. Charles Chubb.[1] The latter must therefore be considered the proper type locality of *Halcyon humii* Sharpe.

Measurements of the specimens of *Sauropatis chloris armstrongi* examined in the present connection are presented in the appended table.

Measurements of specimens of Sauropatis chloris armstrongi.

Museum and number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 153794	Male...	Prahmon, Trang, Lower Siam.	Mar. 22, 1896	Dr. W. L. Abbott.	228.5	94	61	40	15
U.S.N.M. 153793	...do...	Trang, Lower Siam	Mar. 1, 1896	.....do.......	241.5	103	62	42.5	16
U.S.N.M. 173042	...do....	Pulo Lankawi, Malay Peninsula.	Dec. 2, 1899	.....do......	241.5	101.5	67.5	41.5	16
U.S.N.M. 173040	...do...	Bentinck Island, Mergui Archipelago, Malay Peninsula.	Mar. 9, 1900	.....do......	254	101	68	43	15.5
U.S.N.M. 173039	...do...	Loughborough Island, Mergui Archipelago, Malay Peninsula.	Jan. 24, 1900	.....do......	241.5	99	63.5	42	16
U.S.N.M. 173041	...do...	Victoria Point, Tenasserim.	Mar. 30, 1900	.....do......	248	106	65	42.5	17
M.C.Z. 34775	[Male.].	India..............	....	....	....	109	71.5	41.3	16.2
U.S.N.M. 248977	...do...	Klong Yai, southeastern Siam.	Jan. 6, 1915	C. B. Kloss..	....	98	65	43	13
M.C.Z. 25906	Male...	Cochin China......	Oct. 22, 1879	Gilbert Tivant.	....	95.5	59	38.5	15.2
U.S.N.M. 153795	Female	Prahmon, Trang, Siam.	Mar. 26, 1896	Dr. W. L. Abbott.	241.5	98.5	64	41	15
U.S.N.M. 175056	...do...	Tanjong Laboha, Tringganu, Malay Peninsula.	Sept. 30, 1900	.....do......	238.5	95.5	65	40.5	15
U.S.N.M. 153792	...do...	Trang, Lower Siam	Feb. 25, 1896	.....do......	241.5	101	64.5	41.5	16.5
U.S.N.M. 173043	...do...	Pulo Lankawi, Malay Peninsula.	Dec. 2, 1899	.....do......	254	104.5	69	43	16.5
U.S.N.M. 79247	...Im....	Malacca...........	....	....	....	98	63	37.5	15
U.S.N.M. 28546	....	India..............	—— 1839	Barrot......	....	101	63	45.5	15

[a] Measured in the flesh by the collector.

SAUROPATIS CHLORIS DAVISONI (Sharpe).

Halcyon humii subsp. β. *davisoni* SHARPE, Cat. Birds Brit. Mus., vol. 17, 1892, p. 282 (Andaman Islands).

Subspecific characters.—Similar to *Sauropatis chloris armstrongi*, but male with all the posterior lower surface and the white cervical collar usually much suffused with buff; upper parts averaging duller, more greenish, particularly on the back just below the white collar, where the greenish is often shaded with dusky; ear-coverts usually more blackish; black nuchal band more conspicuous, less washed with greenish; female with white cervical collar tinged with buff; and with the back blackish just below this white collar.

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[1] In a letter.

Measurements.—Male:[1] wing, 100–104 (average, 101.3) mm.; tail, 66–69.5 (67.2); exposed culmen, 39–43 (40.8); tarsus, 14–16.5 (15.5).

Female:[2] Wing, 101.5–106.5 (average, 104.5) mm.; tail, 67.5–71 (69.6); exposed culmen, 40–41.5 (40.8); tarsus, 15–16.5 (15.7).

Both sexes:[3] Wing, 100–106.5 (average, 103.1) mm.; tail, 66–71 (68.6); exposed culmen, 39–43 (40.8); tarsus, 14–16.5 (15.6).

Type locality.—Aberdeen, South Andamans.[4]

Geographic distribution.—Andaman Islands.

Remarks.—The strong buff tinge of the whitish cervical collar and of the posterior lower parts is the most conspicuous, though not the only, character separating this form from *Sauropatis chloris armstrongi*, and, indeed, from the other subspecies of *Sauropatis chloris* as well. This buff suffusion is not due to immaturity, as some ornithologists appear to have supposed, but is present in all adult *males*, with, of course, some individual variation in extent and intensity; and is almost entirely lacking in the females, excepting on the cervical collar, where, however, it is less pronounced than in the males. The female of *Sauropatis chloris davisoni* is superficially very much like the same sex of *Sauropatis chloris armstrongi*, but, with the exception of the buff tinge on the lower parts, differs as does the male, though in somewhat less degree. From *Sauropatis chloris cyanescens* the present race may be distinguished by its smaller size; strong buff suffusion on the white cervical collar and posterior lower parts; duller, darker, and more greenish upper surface, with a dusky shade on the back just below the white cervical collar. From *Sauropatis chloris chloroptera*[5] the Andaman race differs so much in its reduced size and strong suffusion of buff on lower parts and cervical collar that more detailed comparison is unnecessary.

The female of *Sauropatis chloris davisoni*, except in the conspicuous lack of buff on the under surface, differs rather less from the male than does the female in some other forms: She is rather duller, more greenish above, particularly on the wings, and has more noticeably blackish ear-coverts and nuchal band. The immature female is more brownish on the upper surface than the adult, duller on the wings, and has the white feathers of cervical collar and breast tipped with dusky. An immature male from Macpherson Strait, South Andaman Island, differs from the adult of the same sex principally in its duller, less bluish upper surface, including the wings, and in the dusky tips on the cervical collar and entire breast.

The colors of the soft parts in this race, as noted on specimen labels, are: Bill black, the basal portion of mandible white or pinkish gray; feet dull or light purplish brown.

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[1] Four specimens, from the Andaman Islands.

[2] Five specimens, from the Andaman Islands.

[3] Nine specimens, from the Andaman Islands.

[4] Type of male in British Museum.

[5] See p. 379.

The locality given in the original description of this race[1] was simply Andaman Islands. The type of the male in the British Museum[2] came from Aberdeen, South Andamans; the female from the Little Coco Islands. The male should be considered *the* type, and the type locality thus Aberdeen.

Measurements of the specimens examined are given in the following table:

Measurements of specimens of Sauropatis chloris davisoni.

Museum and number	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 178834	Male...	Cinque Islands, Andaman Islands.	Jan. 18, 1901	Dr. W. L. Abbott.	248	104	69.5	43	16.5
U.S.N.M. 178832	Male... im.	Macpherson Strait, South Andaman Island, Andaman Islands.	Jan. 14, 1901	.....do......	....	100	66	41	16
U.S.N.M. 178550	Male...	.....do............	.....do.......	.....do......	238.5	100	66	40	15.5
J. H. Fleming 19244	Male... im.	Andaman Islands..	Oct. 5, 1905	B. B. Osmaston.	....	......	.....	39	14
U.S.N.M. 178835	[Female]	Cinque Islands, Andaman Islands.	Jan. 18, 1901	Dr. W. L. Abbott.	....	106.5	70	41	16.5
U.S.N.M. 178549	Female	.....do............	.....do.......	.....do......	....	104.5	71	41.5	15.5
U.S.N.M. 178833	...do....	South Andaman Island, Andaman Islands.	Jan. 14, 1901	.....do......	248	105.5	70	40	16
J. H. Fleming 19243	...do....	Stewart's Island, Andaman Islands.	Jan. 29, 1905	B. B. Osmaston.	....	101.5	67.5	41	15
J. H. Fleming.	Female im.	Andaman Islands..	Feb. 17, 1905	.....do......	....	......	.....	40.5	15.5

[a] Measured in the flesh by the collector.

SAUROPATIS CHLORIS AZELA, new subspecies.

Subspecific characters.—Most like *Sauropatis chloris davisoni*, but tail somewhat shorter; in the male, entirely lacks buff on the light cervical collar, and has much less buff on lower parts, this color being confined to sides and flanks; in the female the upper surface is darker and more brownish.

Description.—Type, adult male, No. 180686, U.S.N.M.; Engano Island, western Sumatra, November 19, 1904; Dr. W. L. Abbott. Back, scapulars, and pileum, brownish bottle green, rather darkest and most brownish on the last; a large, almost concealed patch of white on the occiput; a narrow blackish nuchal band; a broad white cervical collar; lower back, rump, and upper tail-coverts, bluish beryl green; wings fuscous, the lesser and median coverts dull green, rather lighter and more bluish than the back, the greater coverts and exposed portions of wing-quills, excepting the tips, deep turquoise blue, in places more greenish; tail of the same color; lores black; supraloral spot creamy white; a narrow line over the eye and a spot on lower eyelid white; remainder of sides of head dull bottle green, the posterior auriculars blackish; entire lower surface white, the sides of body washed with buff.

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[1] Sharpe, Cat. Birds Brit. Mus., vol. 17, 1892, p. 282.

[2] Mr. Charles Chubb, in a letter.

Measurements.—Male:[1] Total length,[2] 228–235 (average, 232.7) mm.; wing, 100–103 (101.7); tail, 63–66.5 (64.3); exposed culmen, 39.5–41.5 (40.7); tarsus, 15.5–16 (15.7).

Female:[3] Total length,[2] 231–241 (average, 237.2) mm.; wing, 100–103 (101.3); tail, 63.5–68.5 (65.9); exposed culmen, 42–44.5 (43.1); tarsus, 15–16 (15.4).

Both sexes:[4] Total length,[2] 228–241 (average, 235.3) mm.; wing, 100–103 (101.4); tail, 63–68.5 (65.2); exposed culmen, 39.5–44.5 (42.1); tarsus, 15–16 (15.5).

Type locality.—Engano Island, Barussan Islands, western Sumatra.

Geographic distribution.—Engano Island, western Sumatra.

Remarks.—This island race is decidedly smaller than *Sauropatis chloris chloris*, *Sauropatis chloris cyanescens*, *Sauropatis chloris collaris*, and *Sauropatis chloris chloroptera;*[5] and, curiously enough, like forms of so many other species from the islands off the western coast of Sumatra most closely resembles the race indigenous to the Andaman Islands—another case, apparently, of parallel development. It may be distinguished from *Sauropatis chloris cyanescens* by its much smaller size; in the male by darker, more greenish (less bluish) upper parts, with thus more contrast between back and wings; and, in the female, by darker, more olive brownish upper surface. From *Sauropatis chloris armstrongi* it may, in the male, be separated by its darker, more brownish and greenish upper parts; usually more greenish wings; more blackish ear-coverts; more conspicuous blackish nuchal band; and less pronounced buffy suffusion on the sides and flanks; and, in the female, by darker, somewhat more olivaceous upper surface; more greenish (less bluish) wings; wider blackish nuchal band; and ordinarily more blackish auriculars. The female of *Sauropatis chloris azela* differs from the male in much darker, duller, more brownish upper parts, more greenish wings, and lack of any buff on sides and flanks.

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[1] Three specimens, from Engano Island.

[2] Measured in the flesh by the collector.

[3] Four specimens, from Engano Island.

[4] Seven specimens, from Engano Island.

[5] See p. 379.

Measurements of the type series are as below:

Measurements of specimens of Sauropatis chloris azela.

U.S.N.M. number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm*	*mm.*	*mm.*
180686...	Male...	Engano Island, western Sumatra.[b]	Nov. 19, 1904	Dr. W. L. Abbott.	228	102	63.5	41.5	15.5
180687...	...do....	.....do.............	Nov. 24, 1904	.....do......	235	103	66.5	41	16
180685...	...do....	.....do.............	Nov. 17, 1904	.....do......	235	100	63	39.5	15.5
180682...	Female	.....do.............	Nov. 2, 1904	.....do......	241	103	65.5	42	16
180684...	...do....	.....do.............	Nov. 11, 1904	.....do......	241	102	68.5	44.5	15
180683...	...do....	.....do.............	Nov. 3, 1904	.....do......	236	100	63.5	43.5	15.5
180681...	...do....	.....do.............	Nov. 2, 1904	.....do......	231	100	66	42.5	15

[a] Measured in the flesh by the collector. [b] Type.

SAUROPATIS CHLORIS CHLOROPTERA, new subspecies.

Subspecific characters.—Similar to *Sauropatis chloris cyanescens*, but wing and tail longer; male with upper parts, particularly the exposed upper surface of the closed wings, much more greenish; pileum usually darker; black nuchal band averaging rather narrower and more washed with green; auriculars less green-washed; and the sides and flanks noticeably tinged with buff; female with upper parts much duller, more brownish olive; exposed upper surface of closed wings more greenish.

Description.—Type, adult male, No. 179771, U.S.N.M., Sibabo Bay, Simalur Island, northwestern Sumatra, October 23, 1902; Dr. W. L. Abbott. Back and scapulars terre-verte green;[1] pileum similar, but darker and much tinged with olive brown; a large concealed white occipital patch; a narrow black nuchal band, succeeded posteriorly by a wide white cervical collar; lower back, rump, and upper tail-coverts, bluish beryl green; wings fuscous, the lesser coverts mostly terre-verte green like the back, the other wing-coverts bluish beryl green, the exposed surface of the wing quills, except at the tips, deep turquoise blue; tail deep turquoise blue; lores black; supraloral spot creamy white; a narrow line over the eye and a spot on lower eyelid white; otherwise the sides of the head are terre-verte green, excepting the posterior portion of auriculars, which is blackish, continuous with the black nuchal band; entire lower surface, including the lining of wings, white, the sides of body strongly washed with buff; feet dark brown; bill black, the basal two-thirds of mandible white.

Measurements.—Male:[2] Wing, 107–118 (average, 112.8) mm.; tail, 72–78 (74.2); exposed culmen, 44.5–49 (46.7); tarsus, 16.3–18 (17.1).

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[1] Ridgway, Nomenclature of Colors for Naturalists, 1886.

[2] Ten specimens, from Simalur Island and the Batu Islands.

Female:[1] Wing, 108–117.5 (average, 112.6) mm.; tail, 69–78 (73.7); exposed culmen, 43.5–50 (46.8); tarsus, 16–18 (16.9).

Both sexes:[2] Wing, 107–118 (average, 112.7) mm.; tail, 69–78 (74); exposed culmen, 43.5–50 (46.7); tarsus, 16–18 (17).

Type locality.—Sibabo Bay, Simalur Island, Barussan Islands, western Sumatra.

Geographic distribution.—Simalur Island, Pulo Siumat (near Simalur Island), the Batu Islands, Pagi Islands, and, excepting Nias Island, doubtless other adjacent and intervening islands of the Barussan chain.

Remarks.—The most conspicuous characters separating this new subspecies from *Sauropatis chloris cyanescens* are its more greenish wings and upper parts, and larger size. As in all the races of this difficult species these characters are not entirely constant, but are excellent average distinctions. The buffy suffusion on the sides is not due to immaturity, and seems to be, as in *Sauropatis chloris davisoni*, a reliable character, for in *Sauropatis chloris* and *Sauropatis chloris cyanescens* it appears but seldom and then usually as a mere trace. From *Sauropatis chloris armstrongi* of the Malay Peninsula the present form differs in its very much larger size; also, in the male, in much more greenish upper parts, especially exposed surface of closed wings; darker more brownish pileum; more blackish auriculars and nuchal band; rather smaller white supraloral spot; and somewhat less pronounced buffy suffusion on the sides and flanks; and, in the female, by reason of much more olive brownish (less bluish) upper surface; less greenish ear-coverts; wider black nuchal band; and more greenish (less bluish) outer edges of the upper surface of the wing-quills. It may be separated from *Sauropatis chloris azela* by its much larger size; also, in the male, by the more greenish outer edges of the superior surface of wing-quills; and, in the female, by the same character as well as by lighter upper parts. Compared with *Sauropatis chloris davisoni* it is much larger; the male is without buffy suffusion on the white cervical collar; has much less buff on the lower parts, and this restricted to sides and flanks; the upper surface darker, usually more brownish, particularly on the pileum; the ear-coverts more blackish; and the black nuchal band more in evidence; while the female is darker, more olive brownish above; with the ear-coverts less greenish; the exposed outer edges of superior surface of wing-quills more greenish (less bluish); the under surface and white cervical collar without creamy wash.

The female of *Sauropatis chloris chloroptera* may be distinguished from the male by the noticeably duller, more brownish back, less bluish wings, and entire lack of buffy suffusion below.

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[1] Seven specimens, from Simalur Island, North Pagi Island, and the Batu Islands.

[2] Seventeen specimens, from Simalur Island, North Pagi Island, and the Batu Islands.

The bird from the Pagi Islands appears to be the same as that from Simalur Island, though we have but a single example, and that a female, for comparison. Birds from the Batu Islands are somewhat lighter in color above than typical *Sauropatis chloris chloroptera* from Simalur Island, and also average slightly smaller; but these differences do not now appear significant enough for subspecific distinction. These Batu Islands birds are, in fact, intermediate between *Sauropatis chloris chloroptera* of Simalur Island and *Sauropatis chloris amphiryta* of Nias Island,[1] but are nearer the former, with which, for the present, we include them. Average measurements of examples from the different islands compare as follows:

Localities.	Wing.	Tail.	Exposed culmen.	Tarsus.
Five males, from Simalur Island and Pulo Siumat	114.2	74.7	47.5	17.2
Five males, from the Batu Islands	111.3	73.7	45.9	16.9
One female, from Simalur Island	114.5	73	50	17
One female, from North Pagi Island	113	72	....	16
Five females, from the Batu Islands	112.2	74.2	46	17.1

The data on the colors of the soft parts gleaned from the labels of the specimens examined are as follows: In the adult the iris is dark brown, light brown or brownish black; the bill black or blackish blue; the basal portion of mandible white; and the feet gray, bluish gray, dull olive, dark brown or black. In the juvenile stage the iris is given as light brown; the bill black, with basal part of mandible white; and the feet gray.

Detailed measurements of the specimens examined are added herewith:

Measurements of specimens of Sauropatis chloris chloroptera.

Museum and number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
U.S.N.M. 179199	Male...	Simalur Island, western Sumatra.	Nov. 25, 1901	Dr. W. L. Abbott.	276.5	115	78	48	18
U.S.N.M. 179200	...do....	Pulo Siumat, western Sumatra.	Dec. 29, 1901	.....do.......	263.5	116	75	46	17
U.S.N.M. 179769	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 22, 1902	.....do.......	276	114.5	72.5	48	17
U.S.N.M. 179771	...do....	.....do.[b]...........	Oct. 23, 1902	.....do.......	260.5	117.5	75	49	17
U.S.N.M. 179198	...do....	Simalur Island, western Sumatra.	Dec. 2, 1901	.....do.......	....	108	73	46.5	17
A. N. S. Phila. 56149	...do....	Pulo Tana Masa, Batu Islands, western Sumatra.	———, 1896	J. Z. Kannegieter.	....	109	75	44.5	17
A. N. S. Phila. 56151	...do....	Pulo Pini, Batu Islands, western Sumatra.	Oct.-Nov., 1896.	.....do.......	....	107	73	46	16.5

[a] Measured in the flesh by the collector.

[b] Type.

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[1] See p. 382.

Measurements of specimens of Sauropatis chloris chloroptera—Continued.

Museum and number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
A. N. S. Phila. 56150	Male...	Pulo Pini, Batu Islands, western Sumatra.	Oct–Nov., 1896.	J. Z. Kannegieter.	....	108	74.5	44.5	16.3
A. N. S. Phila. 56155	...do....	Pulo Tello, Batu Islands, western Sumatra.	Aug. 1, 1896	.....do......	....	118	74	47.5	17.8
A. N. S. Phila. 56154	...do....	.....do..............	.....do.......	.....do......	....	114.5	72	47	17
U.S.N.M. 179764	Female, im.	North Pagi Island, western Sumatra.	Jan. 1, 1903	Dr. W. L. Abbott.	260	113	72	......	16
U.S.N.M. 179768	Female.	Batu Islands, western Sumatra.	Feb. 10, 1903	.....do.......	250	108	74	44	17
A. N. S. Phila. 56148	Female, im.	Pulo Tana Masa, Batu Islands, western Sumatra.	Aug. 26, 1896	J. Z. Kannigieter.	....	108.5	69	43.5	17
A. N. S. Phila. 56147	Female.	.....do..............	Oct.-Nov., 1896.	.....do......	....	117.5	78	46.5	16.8
A. N. S. Phila. 56152	...do....	Pulo Tello, Batu Islands, western Sumatra.	Aug. 8, 1896	.....do......	....	117.3	76	50	18
A. N. S. Phila. 56153	...do....	.....do..............	July 31, 1896	.....do......	....	109.5	74	......	16.5
U.S.N.M. 179770	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 23, 1902	Dr. W. L. Abbott.	....	114.5	73	50	17

[a] Measured in the flesh by the collector.

SAUROPATIS CHLORIS AMPHIRYTA, new subspecies.

Subspecific characters.—Similar to *Sauropatis chloris chloroptera*, but slightly smaller; male with upper surface lighter, more clearly greenish (not so dull or olivaceous); sides and flanks much less tinged with buff; female with superior parts lighter, less brownish or olivaceous (more clearly greenish); and auriculars more greenish (less blackish).

Description.—Type, adult male, No. 179765, U.S.N.M.; Lafau, Nias Island, western Sumatra, March 21, 1903; Dr. W. L. Abbott. Back, scapulars, and pileum, sea green, darker and somewhat brownish on the last; a large, almost concealed patch of white on the occiput; a narrow blackish nuchal band, somewhat washed with green; a broad white cervical collar; lower back, rump, and upper tail-coverts, dull bluish beryl green; wings fuscous, the lesser coverts mostly green like the back, the greater coverts and exposed portions of wing-quills, excepting the tips, deep turquoise blue, in places somewhat more greenish; tail of the same color; lores black; supraloral spot creamy white, a narrow line over the eye and a spot on lower eyelid white; remainder of sides of head dull sea green, the posterior auriculars black; entire lower surface white, the sides of body washed with buff.

Measurements.—Male[1]: total length,[2] 260 mm.; wing, 108.5; tail, 75; exposed culmen, 44.5; tarsus, 16.5.

Female[3]: total length,[2] 253–266 (average, 258.8) mm.; wing, 108–114 (111.2); tail, 70–76.5 (73.4); exposed culmen, 44–48 (46.1); tarsus, 16.5–17.5 (17).

Both sexes[4]: total length[2], 253–266 (average, 259) mm.; wing, 108–117.5 (average, 111.8) mm.; tail, 70–76.5 (73.7); exposed culmen, 44–48 (45.8); tarsus, 16.5–17.5 (17).

Type locality.—Lafau, Nias Island, Barussan Islands, western Sumatra.

Geographic distribution.—Nias Island and the northwestern coast of Sumatra.

Remarks.—This race is separable from *Sauropatis chloris cyanescens* by somewhat greater size; also, in the male, by the duller, more greenish or brownish (less bluish) upper parts, and more greenish (less bluish) wings; in the female by more greenish (less bluish) wings, and slightly duller, more olivaceous upper surface. From *Sauropatis chloris azela*, of Engano Island, it is distinguishable by its much larger size; also, in the male, by lighter upper parts and more greenish exposed surface of wing-quills; and, in the female, by much lighter upper surface, and more greenish (less bluish) exposed surface of wing-quills. It differs from *Sauropatis chloris davisoni* in its decidedly larger size; the male is also lighter, rather more greenish (less bluish) above, the exposed surface of the wing-quills much more greenish; the sides, flanks, and white cervical collar with little or no buffy tinge; the female is rather more brownish above, especially on the pileum, with the exposed upper surface of wing-quills more greenish (less bluish), and the cervical white collar and lower parts lacking creamy or buffy tinge.

The female of *Sauropatis chloris amphiryta* differs from the male in much darker, more olivaceous upper parts, and in all lack of buffy on the lower surface.

A single adult male from Loh Sidoh Bay, on the mainland of northwestern Sumatra, agrees so closely with specimens of the present race from Nias Island that it seems to be referable here rather than to any of the other subspecies.

The colors of soft parts, so far as mentioned on the labels of specimens are: Maxilla black; mandible pinkish white, with tip and edges black.

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[1] One specimen, from Nias Island.

[2] Measured in the flesh by the collector.

[3] Four specimens, from Nias Island.

[4] Six specimens, from Nias Island.

Measurements of the specimens examined are given in the subjoined table:

Measurements of specimens of Sauropatis chloris amphiryta.

U.S.N.M. number.	Sex.	Locality.	Date.	Collector.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*
179765	Male....	Lafau, Nias Island, western Sumatra.[b]	Mar. 21, 1903	Dr. W. L. Abbott.	260	108.5	75	44.5	16.5
180868	Female..	.....do..............	Mar. 2, 1905	.....do.......	266	112	74	48	17
180866	...do.....	.....do..............	Feb. 26, 1905	.....do.......	261	114	76.5	45.5	17
179767	...do.....	.....do..............	Mar. 22, 1903	.....do.......	253	111	73	44	17.5
179766	...do.....	.....do..............	Feb. 26, 1905	.....do.......	255	108	70	47	16.5
180867	....	.....do..............	.....do........	.....do.......	....	117.5	73.5	46	17.5
179201[c]	Male....	Loh Sidoh Bay, northwestern Sumatra.	Nov. 8, 1901	.....do.......	249	108	68.5	40.5	16.5

[a] Measured in the flesh by the collector. [b] Type. Not used in measurement averages.

SAUROPATIS CHLORIS VIDALI (Sharpe).

Halcyon chloris subsp. *β. vidali* Sharpe, Cat. Birds Brit. Mus., vol. 17, 1892, p. 278 (Ratnagiri and Kelsi Creek, South Konkan, Western India).

Subspecific characters.—Similar to *Sauropatis chloris cyanescens*, but lower parts with more creamy tinge; black nuchal band obsolete or absent; and auriculars green.

Measurements.—Both sexes[1]: Wing, 111–115 mm.; tail, 70–76; culmen, 53; tarsus, 15–16.5.

Type locality.—Kelsi Creek, South Konkan, western India.[2]

Geographic distribution.—Konkan, western India.

Remarks.—Although not examined, this form, as its isolated range would indicate, appears to be separable from both *Sauropatis chloris cyanescens* and *Sauropatis chloris armstrongi*. It is decidedly larger than the latter, and it seems not to be the same as the new race above described from Simalur Island, western Sumatra, *Sauropatis chloris chloroptera*, since it differs in its more bluish wings, obsolescence or lack of the black nuchal band, and wholly green auriculars.

Mr. C. Chubb informs me[3] that the male type of this race in the British Museum is from Kelsi Creek, South Konkan, western India; and that the female type came from Ratnagiri, South Konkan. The former should, therefore, be considered the type, and Kelsi Creek consequently the type locality.

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[1] Two specimens, measured by Sharpe.

[2] Type of male in British Museum; according to Mr. Charles Chubb.

[3] In a letter.

SAUROPATIS CHLORIS ABYSSINICA (Pelzeln).

Ceryle abyssinica LICHTENSTEIN, Nomenclator Avium Mus. Zool. Berol., 1854, p. 67 (nomen nudum).

Halcyon (*Ceryle*) *abyssinica* PELZELN, Sitz. k. Akad. Wiss. Wien, vol. 20, 1856, p. 500 (*Abyssinia*).

Subspecific characters.—Similar to *Sauropatis chloris cyanescens*, but smaller; more greenish, particularly on the exposed surface of wings; no black nuchal band; ear-coverts greenish.

Measurements.[1]—Wing, 104; tail, 68; culmen, 50; tarsus, 14 mm.

Type locality.—Coast of Red Sea, Abyssinia.

Geographic distribution.—Red Sea coast of Abyssinia.

Remarks.—This race may easily be distinguished from *Sauropatis chloris chloroptera* by its smaller size, greenish ear coverts, and lack of black nuchal band. The subspecific name *abyssinica* as here applied is usually credited to Lichtenstein, but this author's *Ceryle abyssinica*[2] is a *nomen nudum.* The first tenable use of the name is apparently Pelzeln's.[3]

SAUROPATIS CHLORIS ANACHORETA (Reichenow).

Halcyon anachoreta REICHENOW, Ornith. Monatsber., vol. 6, No. 3, March, 1898, p. 47 (Hermit Islands, western Admiralty Islands).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but decidedly larger.

Measurements.—Both sexes:[4] Wing, 122–125; tail, 95; culmen, 60; tarsus, 15 mm.

Type locality.—Hermit Islands, western Admiralty Islands, off northeastern New Guinea.

Geographic distribution.—Hermit Islands, in the western part of the Admiralty Islands.

Remarks.—This form I have not seen, but unless there is a hidden discrepancy due to difference in method of measuring, it is easily recognizable by its great size alone, as it is larger than any other race of *Sauropatis chloris.* Doctor Reichenow says,[5] also, that the crown is more purely blue green, and that the white supraloral spot is larger than in *Sauropatis chloris chloris;* but these differences are not of much diagnostic value unless based upon a series of specimens, which Doctor Reichenow appears not to have had.

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[1] One specimen, measured by Sharpe.

[2] Nomenclator Avium Mus. Zool. Berol., 1854, p. 67.

[3] *Halcyon* (*Ceryle*) *abyssinica* Pelzeln, Sitz. k. Akad. Wiss. Wien, vol. 20, 1856, p. 500.

[4] Measured by Reichenow.

[5] Ornith. Monatsber., vol. 6, No. 3, March, 1898, p. 47.

SAUROPATIS CHLORIS SOLOMONIS (Ramsay).

Halcyon solomonis Ramsay, Proc. Linn. Soc. New South Wales, vol. 6, 1881, p. 833 (Solomon Islands).

Halcyon salamonis Ramsay, Proc. Linn. Soc. New South Wales, vol. 7, 1882, p. 21 (Ugi Island and St. Christoval Island, Solomon Islands)

Halcyon salmonis Ramsay, Nature, vol. 25, 1882, p. 355 (Solomon Islands).

Sauropatis salomonis Salvadori, Ann. Mus. Civ. Stor. Nat. Genova, vol. 18, 1882, p. 420.

Halcyon solomonensis Sharpe, Cat. Birds Brit. Mus., vol. 17, 1892, pl. 7, fig. 2 (Solomon Islands).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but much smaller; white occipital patch obsolescent; supraloral spot reduced, sometimes absent; male with head more bluish; female much duller, darker, above than the female of *Sauropatis chloris chloris*, the back below the white collar more blackish, the head more dusky or brownish; exposed surface of wing-quills more purely blue (less greenish).

Measurements.—Female:[1] Wing, 91 mm.; tail, 63; culmen, 45.5; tarsus, 12.5.

Type locality.—Ugi Island, Solomon Islands.

Geographic distribution.—Solomon Islands; together with probably the islands of New Britain and New Ireland.

Remarks.—There is little difficulty in distinguishing this well-marked form from *Sauropatis chloris chloris*, by its small size and the dark upper surface of the female; it is, however, more closely allied to *Sauropatis chloris sordida*.

It may be worth while to call attention to the original description of *Halcyon chloris solomonis*,[2] as above given, for the subspecific name is commonly cited from the Proceedings of the Linnaean Society of New South Wales for 1882, where it is spelled *salamonis*.

SAUROPATIS CHLORIS HYPERPONTIA, new subspecies.

Subspecific characters.—Similar to *Sauropatis chloris solomonis*, but larger; female with head darker; no line of white over the eye; no white in lower part of eye-ring; white occipital patch larger; outer under wing-coverts mottled with blackish brown and dark greenish.

Description.—Type, nearly adult (female?), No. 102000, U.S.N.M.; Havannah Harbor, Vaté Island (Efate, or Sandwich Island), New Hebrides Islands, Melanesia. Back and scapulars dark oily bottle green; forehead olive brown; rest of pileum olive brown tinged with greenish, shading on the occiput into the dark green color of the back; a large, almost concealed white occipital patch; a rather wide ack nuchal band; a broad white cervical collar (a few of the unworn tips of this with small flecks of blackish); lower black, rump, and upper tail-coverts, sea green; wings fuscous, the tertials, lesser and median coverts, green like the back, the greater series and alula, bluish sea green, the exposed portions of primaries and secondaries, excepting the fuscous tips, deep greenish cerulean blue; tail myrtle green; lores dark olive brown; supraloral spot rather small, creamy white; a spot on lower eyelid white, but no white feathers in the dark brown eye-ring; superciliary and postocular regions greenish olive like the crown; auricular, subocular, and malar regions brownish black; entire lower surface white, (a few dusky edgings on the sides of throat and breast); under wing-coverts white exteriorly, much mixed with dark brown and dull greenish.

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[1] One specimen, measured by Sharpe.

[2] Ramsay, Proc. Linn. Soc. New South Wales, vol. 6, 1881, p. 833.

Measurements.—Female[1]: wing, 102 mm.; tail, 66.5; exposed culmen, 44.5; tarsus, 16.5.

Type locality.—Havannah Harbor, Vaté Island, New Hebrides Islands, Melanesia.

Geographic distribution.—New Hebrides Islands.

Remarks.—The only specimen we have is an adult, presumably a female, but this differs so radically from females of the other races that it can scarcely belong to any of them. Compared with the same sex of *Sauropatis chloris chloris* it is much smaller; has no white line over the eye; has the white supraloral spot smaller; the upper parts much darker throughout; the pileum more brownish; the back just below the white collar blackish; outer edges of wing-quills much more bluish (less greenish) and thus more contrasted with the interscapulum; no white in the lower part of the orbital feathering; black nuchal band wider; and the outer under wing-coverts mottled with blackish brown and dark greenish. It differs from *Sauropatis chloris sordida*, of Australia, in smaller size; darker, more greenish (less olivaceous) upper parts, the mantle below the white collar being blackish; more bluish outer vanes of wing-quills; larger white occipital patch; somewhat smaller white supraloral spot; more blackish ear-coverts; and the extensive admixture of dark brown and dark greenish on the under wing-coverts, this existing to a much greater degree than in even the juvenal stage of any form of *Sauropatis chloris* examined. From *Sauropatis chloris colonus*, of the Louisiade Archipelago, *Sauropatis chloris hyperpontia* may be distinguished by its greater size; rather lighter upper surface; more bluish (less greenish) outer vanes of wing-quills; much less or no buffy wash on white areas; lack of any indication of a white superciliary stripe; and by the considerable admixture of blackish brown and dark greenish in the white of the outer under wing-coverts, which parts are pure white in *Sauropatis chloris colonus*.

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[1] One specimen, the type.

SAUROPATIS CHLORIS SUVENSIS (Sharpe).

Halcyon suvensis SHARPE, Cat. Birds Brit. Mus., vol. 17, 1892, p. 281 (Suva Island, Fiji Islands).

Subspecific characters.—Similar to *Sauropatis chloris solomonis*, but slightly smaller; (female) with no green on auriculars or below eye; entire mantle blackish; flanks and crissum washed with ochraceous.

Measurements.—[Female?]:[1] Wing, 91 mm.; tail, 61.5; culmen, 41; tarsus, 15.5.

Type locality.—Suva Island, Fiji Islands.

Geographic distribution.—Fiji Islands.

Remarks.—This race was described by Doctor Sharpe[2] from a single specimen in the British Museum supposed to be an immature male, but which will probably be found to be a female. It is apparently a recognizable form, though more specimens are necessary for a final judgment.

SAUROPATIS CHLORIS COLONUS (Hartert).

Halcyon sordidus colonus HARTERT, Novit. Zool., vol. 3, No. 3, September 18, 1896, p. 244 (Egum Island, Louisiade Archipelago).

Subspecific characters.—Resembling *Sauropatis chloris suvensis*, but concealed white patch on occiput larger, and female without ochraceous tinge on posterior lower parts.

Measurements.—Male:[3] Wing, 92.5 mm.; tail, 70.5; exposed culmen, 40; tarsus, 14.3.

Female:[4] Wing, 88.5–92.5 (average, 90.8) mm.; tail, 64–68 (66); exposed culmen, 38.3–41 (39.6); tarsus, 14–16 (14.8).

Both sexes: Wing, 88.5–92.5 (average, 91.3) mm.; tail, 64–70.5 (67.1); exposed culmen, 38.3–41 (39.7); tarsus, 14–16 (14.7).[5] Wing, 86–95 (90.7).[6]

Type locality.—Egum Island, Louisiade Archipelago, off southeastern New Guinea.

Geographic distribution.—Louisiade Archipelago.

Remarks.—This subspecies differs from *Sauropatis chloris chloris* by reason of much smaller size; the male also in darker, more greenish (less bluish) upper parts; more greenish wings; still more solidly black ear-coverts, with scarcely a wash of bluish or greenish; less evident white superciliary stripe; and narrower black nuchal band, more overlaid with greenish; the female also in having darker, more blackish upper parts, particularly the pileum and that part of the back just below the white collar; the whitish superciliary stripe less distinct; the supraloral spot and white cervical collar more deeply tinged with ochraceous or buff. From *Sauropatis chloris sordida* it may be distinguished by its much smaller measurements; also, in the male, by the darker, more greenish (less brownish) upper surface, especially on the pileum; evident white superciliary stripe; less greenish (more blackish) ear-coverts; more bluish (less greenish or brownish) superior wing-coverts; and rather more greenish wing-quills; and, in the female, by darker, more blackish (much less brownish) superior surface; more greenish (less bluish) wings; less greenish (more blackish) ear-coverts; more buffy or ochraceous-washed cervical collar and supraloral spot; and the presence of a more or less well-indicated superciliary stripe.

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[1] One specimen, measured by Sharpe.

[2] Cat. Birds Brit. Mus., vol. 17, 1892, p. 281.

[3] One specimen, from the Louisiade Islands.

[4] Three specimens, from the Louisiade Islands.

[5] Four specimens, from the Louisiade Islands.

[6] Eleven specimens, measured by Hartert.

The female of *Sauropatis chloris colonus* differs from the male in having the upper parts much darker, more blackish, particularly on the pileum and upper back; wings above duller, less bluish (more greenish); auriculars somewhat more blackish (less washed with green; only very slightly so tinged even in the male); supraloral spot and whitish cervical collar more washed with buff or ochraceous; and throat less purely white, more creamy or buffy.

As in most of the forms of this species, there is much individual variation in color, both in the male and female; this involving chiefly the bluish or greenish shade of the upper parts, including the wings, and, particularly in the female, depth of the buffy suffusion on the white cervical collar, and the extent of blackish on the back below this collar.

No specimens have been examined from outside the Louisiade Archipelago; in fact, this race has not been recorded from elsewhere. It is fair to presume, therefore, that *Sauropatis chloris colonus* is confined to these islands.

Detailed measurements are as follows:

Measurements of specimens of Sauropatis chloris colonus.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
J. H. Fleming 20469.	Male....	St. Aignan Island, Louisiade Archipelago.	Apr. 12, 1897	A. S. Meek.....	92.5	70.5	40	14.8
J. H. Fleming 20467.	Female..	.....do................	July 9, 1897	.....do..........	92.5	68	38.3	14.5
J. H. Fleming 20470.	...do.....	.....do................	.....do.......	.....do..........	88.5	64	41	16
J. H. Fleming 20471.	...do.....	.....do................	.....do.......	.....do..........	91.5	66	39.5	14

SAUROPATIS CHLORIS GRAYI Cabanis and Heine.

S[auropatis]. *Grayi* CABANIS and HEINE, Mus. Hein., pt. 2, 1860, p. 159 (based on "Halcyon sordida Gray (nec Gould) P. Z. S., 1858, p. 172 [No.] 14") (Aru Islands).

Halcyon chloris aruensis BERLEPSCH, Abhandl. Senckenb. Naturf. Gesells., vol. 34, pt. 1, July 31, 1911, p. 75 (Dobo, Aru Islands).

Subspecific characters.—Similar to *Sauropatis chloris chloris*, but upper parts more greenish or brownish; no green at all on sides of head; blue on outer webs of primaries paler.

Measurements.—Both sexes:[1] Wing, 100–110.5 (average, 105.7) mm.; tail, 71–73 (71.8); culmen, 49–56.5 (53.7);[2] tarsus, 15.5–16.5 (16).

Type locality.—Aru Islands.

Geographic distribution.—Aru Islands.

Remarks.—This bird was described by von Berlepsch[3] under the impression that *Sauropatis chloris sordida* was a distinct species, and that the two occurred together on the Aru Islands. The present writer, not having access to any Aru Island specimens, wrote to Dr. Ernst Hartert for his opinion regarding the status of *Halcyon chloris aruensis*. Doctor Hartert very kindly borrowed for examination the type series, and under date of March 16, 1913, wrote me as follows:

"I have received a long letter from friend Berlepsch and the types of his *Halcyon chloris aruensis*. Though they look very much like *chloris*—are, in my opinion, undoubtedly *blue varieties of H. sordidus!* We have a specimen entirely intermediate between Berlepsch's '*aruensis*' and typical dark *sordidus*."

From this information and the data furnished by the original description of *Halcyon chloris aruensis*, this bird appears to be a recognizable race, combining the characters of *Sauropatis chloris chloris* and *Sauropatis chloris sordida*, and forming the connecting link between these two. It thus becomes evident that *Sauropatis sordida* is a subspecies of *Sauropatis chloris*, with which view of its status the opinion of Doctor Hartert coincides.

Unfortunately for Berlepsch and his name *Halcyon chloris aruensis*, the Aru Islands bird had long previously been named by Cabanis and Heine, by whom it had been called *Sauropatis grayi*,[4] on the basis of a specimen from the Aru Islands briefly described by Gray under the name "*Halcyon sordida* var."[5] The race inhabiting the Aru Islands must therefore bear the name *Sauropatis chloris*

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[1] Six specimens, measured by Berlepsch and Gray.

[2] Doubtless total culmen, and thus not entirely comparable with exposed culmen.

[3] Abhandl. Senckenb. Naturf. Gesells., vol. 34, pt. 1, July 31, 1911, p. 75.

[4] Mus. Hein., pt. 2, 1860, p. 159.

[5] Proc. Zool. Soc. Lond., 1858, p. 172.

grayi Cabanis and Heine. It includes the Aru Islands birds heretofore identified as *Sauropatis chloris sordida.*

SAUROPATIS CHLORIS COLCLOUGHI Mathews.

Sauropatis chloris colcloughi MATHEWS, Bull. Brit. Ornith. Club, vol. 36, No. 213, February 22, 1916, p. 61 (Mud Island, near Brisbane, Queensland, Australia).

Subspecific characters.—Resembling *Sauropatis chloris sordida*, but more brightly colored, the head bluish green instead of brownish; back, wings, and tail, more bluish green (less brownish).

Measurements.—(None given in the original description.)

Type locality.—Mud Island, near Brisbane, Queensland, Australia.

Geographic distribution.—Coast region of southeastern Queensland, Australia.

Remarks.—No examples of this newly described race have been examined, and nothing therefore can be added to the original description, which is as follows:[1]

"Differs from *S. s. sordida* (Gould) in being more brilliantly colored, the blue in all the feathers of the head, back, and tail being most noticeable. The head is bluish green, not greenish brown; the back is also bluish green and the primaries edged with indigo. Tail blue."

Since no measurements or comparisons with forms other than *Sauropatis chloris sordida* were added by its describer, the characters separating it from *Sauropatis chloris grayi*, excepting inferentially the lack of a superciliary stripe, can not now be given. It is, however, possibly a recognizable race.

SAUROPATIS CHLORIS SORDIDA (Gould).

Halcyon sordidus GOULD, Proc. Zool. Soc. Lond., 1842, (December, 1842), p. 72 (northern coast of Australia).

Halcyon sordidus cooktowni MATHEWS, Novit. Zool., vol. 18, No. 3, January 31, 1912, p. 289 (Cooktown, northern Queensland, Australia).

Subspecific characters.—Very much like *Sauropatis chloris solomonis*, but decidedly larger; the blue of upper surface, particularly the wing-quills, somewhat more greenish; superciliary stripe entirely lacking; upper parts in female duller and more brownish.

Measurements.—Both sexes: Wing, 101.5–111.5 (average, 105.9) mm.; tail, 68–73.5 (70.5); exposed culmen, 46.5–50 (47.8); tarsus, 17–18 (17.5).[2] Wing, 105–116 (average, 111.3).[3]

Type locality.—Cape York, northern Queensland, Australia.[4]

Geographic distribution.—Coast region of northern Queensland, Australia.

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[1] *Sauropatis sordida colcloughi* Mathews, Bull. Brit. Orn. Club, vol. 36, No. 213, Feb. 22, 1916, p. 61.

[2] Four specimens, from Australia.

[3] Seven specimens, measured by Hartert.

[4] Designated by Mathews, Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 289.

Remarks.—From the male of *Sauropatis chloris chloris* the same sex of *Sauropatis chloris sordida* differs in having a longer bill; the upper parts, including the wing-coverts, much duller, more brownish or greenish (less bluish); black nuchal band somewhat broader and less overlaid with greenish; no white superciliary stripe; ear-coverts washed with greenish instead of bluish. The female may be distinguished from the female of *Sauropatis chloris chloris* by its longer bill, rather darker, much more brownish (less greenish) upper surface, including the wing-coverts; less greenish wing-quills; and absence of a white superciliary stripe.

The adult male of the present form has a closer resemblance to the adult female of *Sauropatis chloris chloris* than to the same sex of that subspecies, but is distinguishable by longer bill; absence of a white superciliary stripe; more olivaceous or brownish superior wing-coverts and remaining upper parts, especially the pileum; more bluish wing-quills; and more olive greenish auriculars. The adult male of *Sauropatis chloris sordida* is even more like the juvenal female of *Sauropatis chloris chloris*, but is separable by the entire absence of a superciliary stripe; more greenish (less blackish) ear-coverts; more brownish pileum; more bluish (less greenish) wing-quills; and more olivaceous superior wing-coverts.

The female of the present race is appreciably duller throughout than the male, also more brownish above, with more blackish ear-coverts.

The type of *Sauropatis chloris sordida*, which I have examined in the Academy of Natural Sciences of Philadelphia, is apparently a female, since it is dull and brown for an example of even that sex. The locality on the label is the same as that given in the original description—"North coast of Australia," and this is probably correct. Mr. G. M. Mathews has subsequently restricted the type locality to Cape York, northern Queensland.[1]

The other specimen in the Gould collection seems also to be a female. This one is labeled "West coast of Australia," but from the large size of the bill was probably obtained in northern Queensland and incorrectly labeled.

There seems to be little doubt of the subspecific relationship of *Sauropatis sordida* with *Sauropatis chloris*, as Doctor Hartert has already pointed out,[2] since the differences between *Sauropatis chloris sordida* and *Sauropatis chloris solomonis* are practically bridged by individual variation in both color and size, and between the former and *Sauropatis chloris chloris* by individual variation in *Sauropatis chloris grayi*, as already mentioned.[3]

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[1] Novit. Zool., vol. 18, No. 3, Jan. 31, 1912, p. 289.

[2] Idem, vol. 11, No. 1, Mar. 25, 1904, p. 198.

[3] See p. 390.

Measurements of specimens examined are added below:

Measurements of specimens of Sauropatis chloris sordida.

Museum and number.	Sex.	Locality.	Date.	Collector.	Wing.	Tail.	Exposed culmen.	Tarsus.
					mm.	*mm.*	*mm.*	*mm.*
M.C.Z.32229	[Male]...	[Australia]............	....	....	104.5	68	......	17.3
A. N. S. Phila. 21416.	[Female]	North coast of Australia.[a]	....	Gould collection.	106	73.5	47	18
A. N. S. Phila. 50130.	...do.....	Australia.............	—— —, 1850	Warevich......	111.5	71.5	46.5	17
A. N. S. Phila. 21417.	...do.....	"West" coast of Australia.	....	Gould collection.	101.5	69	50	17.5

[a] Type.

SAUROPATIS CHLORIS MELVILLENSIS (Mathews).

Halcyon sordidus melvillensis MATHEWS, Austral Avian Record, vol. 1, No. 2, April 2, 1912, p. 88 (Melville Island, Northern Territory, Australia).

Subspecific characters.—Much like *Sauropatis chloris sordida*, but bill smaller and upper surface paler.

Measurements.—(None given by the original describer.)

Type locality.—Melville Island, Northern Territory, Australia.

Geographic distribution.—Coast region of the Northern Territory, Australia, southwest along the coast to middle Western Australia.

Remarks.—No authentic specimens of this proposed race have been examined, but it will probably be found recognizable, and is therefore given a place here on the strength of the original diagnosis.[1]

KEY TO THE SUBSPECIES OF SAUROPATIS CHLORIS, BASED ON ADULT MALES.

a^1. Larger (wing over 120 mm.)........*Sauropatis chloris anachoreta* (p. 385).
a^2. Smaller (wing under 120 mm.)
b^1. Black nuchal band obsolete or absent (if present, very narrow).
c^1 Larger (wing averaging more than 110 mm.)
d^1 Auriculars green; black nuchal band not distinct.
Sauropatis chloris vidali (p. 384).
d^2 Auriculars mostly blackish; black nuchal band distinct.
Sauropatis chloris teraokai (p. 357).
c^2. Smaller (wing averaging less than 110 mm.).
d^1. Upper parts decidedly bluish.
e^1. Smaller (wing averaging less than 108 mm.); more bluish above
Sauropatis chloris armstrongi (p. 372).
e^2. Larger (wing averaging more than 105 mm.); less bluish above
Sauropatis chloris palmeri (p. 369).
d^2 Upper parts decidedly greenish.
e^1. Exposed surface of wings more bluish; upper surface rather lighter......................*Sauropatis chloris collaris* (p. 361).

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[1] Mr. Mathews, however, has recently (Birds Australia, vol. 7, pt. 2, May 15, 1918, p. 196) relegated this form to the synonymy of *Sauropatis chloris sordida*.

e^2. Exposed surface of wings more greenish; upper surface rather duller..................*Sauropatis chloris abyssinica* (p. 385).

b^2. Black nuchal band broad and conspicuous.

c^1. Wing less than 100 mm.

d^1. Lores, infra-orbital region, and fore part of auriculars black, or but slightly washed with greenish; upper parts darker.

e^1. Concealed white ocipital patch larger; female without ochraceous tinge on posterior lower parts.
Sauropatis chloris colonus (p. 388).

e^2. Concealed white occipital patch smaller; female with ochraceous tinge on posterior lower parts.
Sauropatis chloris suvensis (p. 388).

d^2. Lores, infra-orbital region, and fore part of auriculars greenish or bluish; upper parts lighter.

$e.^1$ Concealed white occipital patch larger; black nuchal band narrower, more washed with greenish; female with upper surface lighter....................*Sauropatis chloris enigma* (p. 360).

$e.^2$ Concealed white occipital patch smaller; black nuchal band wider, and less, or not at all, washed with greenish; female with upper surface darker, on mantle somewhat blackish.
Sauropatis chloris solomonis (p. 386).

$c.^2$ Wing not less than 100 mm.

$d.^1$ Upper parts decidedly more bluish.

e^1. Bill longer (the exposed culmen averaging more than 46 mm.).
Sauropatis chloris cyanescens (p. 365).

e^2. Bill shorter (the exposed culmen averaging less than 46 mm.).

$f.^1$ Upper surface more bluish and less contrasted with wings; blackish nuchal band narrower, less distinct, and more overlaid with greenish or bluish; bill somewhat shorter.

$g.^1$ Sides of body strongly suffused with buff; size somewhat smaller; auriculars more blackish.
Sauropatis chloris meyeri (p. 359).

g^2. Sides of body not strongly, if at all, suffused with buff; size somewhat larger; auriculars more greenish.
Sauropatis chloris forsteni (p. 357).

$f.^2$ Upper surface more greenish and more contrasted with wings; blackish nuchal band wider, more distinct, and less, or not at all, overlaid with green; bill somewhat longer.
Sauropatis chloris chloris (p. 355).

$d.^2$ Upper parts decidedly more greenish.

$e.^1$ Wing averaging less than 105 mm.

$f.^1$ No white line over eye; anterior portion of mantle bordering white cervical collar in female blackish; outer under wing-coverts mottled with dark brown and greenish.
Sauropatis chloris hyperpontia (p. 386).

$f.^2$ A white line over eye; anterior portion of mantle bordering white cervical collar in female not blackish; outer under wing-coverts not mottled.

$g.^1$ White cervical collar tinged with buff; all of lower parts more or less washed with buff.
Sauropatis chloris davisoni (p. 375).

$g.^2$ White cervical collar not tinged with buff; only sides and flanks washed with buff...*Sauropatis chloris azela* (p. 377).

e.^{2} Wing averaging more than 105 mm.

f.^{1} Upper surface much duller, more olivaceous.

g.^{1} Bill smaller............*Sauropatis chloris melvillensis* (p. 393).

g.^{2} Bill larger................*Sauropatis chloris sordida* (p. 391).

f.^{2} Upper surface much brighter, more greenish.

g.^{1} Smaller (wing averaging less than 110 mm.).

h.^{1} Superciliary stripe absent.

Sauropatis chloris colcloughi (p. 391).

h.^{2} Superciliary stripe present.

Sauropatis chloris grayi (p. 390).

g.^{2} Larger (wing averaging not less than 110 mm.).

h.^{1} Upper parts lighter, brighter, less olivaceous.

Sauropatis chloris amphiryta (p. 382).

h.^{2} Upper parts darker, duller, more olivaceous.

Sauropatis chloris chloroptera (p. 379).

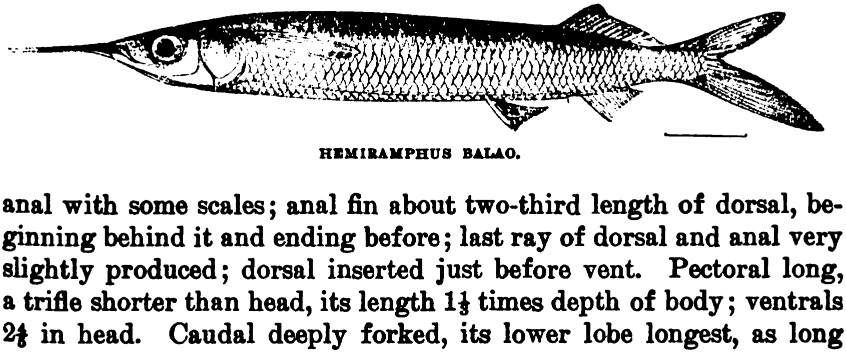
ON A RARE SPECIES OF HALF-BEAK, HEMIRAMPHUS BALAO, FROM CUBA.

By David Starr Jordan,
Of Stanford University, California.

In a small collection of fishes sent from Habana, Cuba, by Dr. John Mez is a specimen of a rare and imperfectly known Half-beak, *Hemiramphus balao* Le Sueur.

This specimen may be briefly described as follows: Head (without lower jaw), 4⅔ in length from tip of snout to base of caudal; depth, 6⅔; eye, 4 in head; snout, 3⅔; D. 13; A. 11; scales, 59.

Body moderately robust, compressed. Lower jaw (broken) from tip to tip of upper but probably about 5½ in distance from its tip to base of caudal. Ventrals inserted at a point midway between middle of base of caudal and the first third of length of pectoral; dorsal, and anal with some scales; anal fin about two-third length of dorsal, beginning behind it and ending before; last ray of dorsal and anal very slightly produced; dorsal inserted just before vent. Pectoral long, a trifle shorter than head, its length 1⅓ times depth of body; ventrals 2⅘ in head. Caudal deeply forked, its lower lobe longest, as long as head.



HEMIRAMPHUS BALAO.

Color in spirits olivaceous, the sides silvery, without lateral band, base of pectoral dusky, upper lobe of caudal dull bluish, with no trace of orange on dorsal or caudal.

Specimens examined, 10½ inches in length.

This species is evidently different from the common "*Escribano*" of the West Indies, *Hemiramphus brasiliensis* (Linnaeus); (*Hemiramphus browni* and *pléei* Cuvier and Valenciennes; *Hemiramphus* *marginatus* Lacépède and Le Sueur; *Hemiramphus filamentosus* Poey.) It has the pectorals longer than in that species, the body rather more slender, the scales smaller,[1] the last ray of dorsal and anal less produced, while it lacks the deep orange shades on dorsal and caudal so conspicuous in the *Escribano.*

I think that Jordan and Evermann[2] were quite right in identifying this fish with *Hemiramphus balao* of Le Sueur, from Guadeloupe, Martinique, and Santo Domingo.

Le Sueur's fish is said to have the anal fin half as long as the dorsal, the rays being, as in the other, D. 14, A. 12 (the last, split ray in each being counted as two). According to Le Sueur, the caudal is bluish, and the pectoral a third shorter than the lower mandible, but longer than in *H. marginatus* (*brasiliensis*), all the fins being longer than in the latter species and the body more slender. *Hemiramphus macrochirus* Poey, from Habana, is clearly identical with *Hemiramphus balao.* The synonymy of these species, as given by Jordan and Evermann, seems to be entirely correct.

I may here note an omission in the work of Jordan and Evermann.[3] The name *Tylosurus argalus* (Le Sueur) should replace *Tylosurus ardeolus* (Cuvier and Valenciennes) if the species in question is valid. Le Sueur's *Belone argalus* was originally described in the Journal of the Academy of Natural Sciences of Philadelphia (vol. 2, p. 125, 1823).

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[1] The statement of Valenciennes that the scales in his *Hemiramphus browni* are 65 is an error. I counted 52 in his types in the museum at Paris. (Martinique, Plée.)

[2] Fishes of North and Middle America, vol. 1, p. 28, 1896.

[3] Fishes of North and Middle America, vol. 1, p. 718.

THE RACES OF THE NICOBAR MEGAPODE, MEGAPODIUS NICOBARIENSIS BLYTH.

By Harry C. Oberholser,
Of the Biological Survey, United States Department of Agriculture.

The Nicobar megapode, *Megapodius nicobariensis*, is of interest as marking the extreme western limit of the geographic range of the Megapodiidae. Furthermore, no members of this family live nearer than the islands off the northern coast of Borneo and the islands in the Java Sea. This species is, therefore, a geographic outlier, as it were, and, as would be expected, apparently a very distinct species, though not, however, distantly related to *Megapodius teninberensis* Sclater and *Megapodius cumingii* Dillwyn.

The material used in the present study is all in the United States National Museum, and consists almost wholly of specimens collected by Dr. W. L. Abbott. Measurements have all been made in millimeters, and in the manner described in the present author's paper on *Butorides virescens*.[1] The names of colors used are from Mr. Ridgway's recently published "Color Standards and Color Nomenclature."

The geographic distribution of *Megapodius nicobariensis* is limited to the Nicobar Islands, off the western coast of the Malay Peninsula, in the southeastern part of the Bay of Bengal, but the species is found on practically all the islands of this group. It has been supposed not to vary subspecifically on any of the islands; but by our present examination two well-defined races are shown to exist, which are hereinafter duly described.

There is apparently no sexual difference, either of size or color, in this species. Considerable individual variation is evident, however, the olivaceous color in some specimens being much more rufescent than in others. Also, what amounts to a gray color phase, independent of sex or age, not infrequently occurs, in which the lower parts are extensively slaty or dark grayish, and even the upper surface is to some extent suffused with the same color. The racial differences are shown in the following account of the subspecies.

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[1] Proc. U. S. Nat. Mus., vol. 42, 1912, p. 533.

MEGAPODIUS NICOBARIENSIS NICOBARIENSIS Blyth.

M[*egapodius*]. *nicobariensis* BLYTH, Journ. Asiat. Soc. Bengal, vol. 15, No. 169, 1846, p. 52 (Nicobar Islands).

Megapodius trinkutensis SHARPE, Ann. and Mag. Nat. Hist., ser. 4, vol. 13, No. 78, June, 1874, p. 448 (Trinkut Island, Nicobar Islands).

Subspecific characters.—Coloration relatively light.

Description.—Adult male, No. 178326, U.S.N.M.; Katchall Island, Nicobar Islands, February 19, 1901; Dr. W. L. Abbott. Pileum dull cinnamon brown; remainder of upper parts rather light brownish olive; tail mummy brown, verging toward Prout's brown; outer webs of primaries pale cinnamon brown; inner webs of primaries and secondaries somewhat light sepia; outer webs of secondaries, together with both webs of tertials and of upper wing-coverts, cinnamon brown verging to ochraceous tawny, the tertials tinged with brownish olive; chin brownish white; throat and sides of head between drab and hair brown; remaining lower parts rather light Saccardo's umber, with edgings, particularly on posterior portion, of light tawny olive, clay color, and dull cinnamon buff; middle of lower breast and of abdomen with a pronounced slaty gray tinge; lining of wing dull tawny olive to pale sepia.

Measurements.—Male[1]: Total length (in flesh), 381–406.4 (average, 392.4) mm.; wing, 206–230 (223.7); tail, 66–73.5 (69.9); exposed culmen, 22–24.5 (23.6); bill from anterior end of nostril, 13–14.5 (13.7); height of bill at base, 11–13 (12); tarsus, 66–69.5 (68.1); middle toe without claw, 40.5–44.5 (42.8).

Female[2]: Total length (in flesh), 387.4–419 (average, 394.4) mm.; wing, 222–233 (225.7); tail, 64–74 (68.9); exposed culmen, 22–24.5 (23.6); bill from anterior end of nostril, 13–14 (13.7); height of bill at base, 11–13 (12.4); tarsus, 63.5–67.5 (66); middle toe without claw, 41–44.5 (42.4).

Type-locality.—Middle group of the Nicobar Islands.

Geographic distribution.—Middle and northern Nicobar Islands.

Remarks.—This species was first discovered by Mr. P. Barbe, but on which island is not known; from the description of the specimen, however, evidently on one of the middle islands. The bird from Trinkut Island was subsequently described by Dr. R. B. Sharpe,[3] but it was found to be identical with the typical form.

This race has been reported from Tillangchong, Camorta, Katchall, Nankauri, Trinkut, Bompoka, and Treis, and probably occurs on other islands in the middle and northern parts of the Nicobar group.

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[1] Ten specimens, from the Islands of Katchall, Tillangchong, Nankauri, and Trinkut, in the Nicobar group.

[2] Nine specimens from the islands of Katchall and Tillangchong.

[3] *Megapodius trinkutensis* Sharpe, Ann. and Mag. Nat. Hist., ser. 4, vol. 13, No. 78, June, 1874, p. 448.

Examples examined from several of these islands show no geographic variation.

Measurements of all the specimens examined are given below:

Measurements of specimens of Megapodius nicobariensis nicobariensis.

[Collected by Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Bill from anterior end of nostril.	Height of bill at base.	Tarsus.	Middle toe without claw.
			1901.	*mm.*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
178327	Male	Katchall I., Nicobar Islands.	Feb. 19	387.4	224	73	22	14.5	12	68	42
178326	do	do	do	406.4	225	72.5	24	14	12	68	44
178329	do	do	Feb. 20	400	220	67	23	14	12	69	44
178328	do	do	Feb. 23	381	222	66	24.5	13	12.5	68	44.5
178336	do	Tillangchong I., Nicobar Islands.	Jan. 30	381	230	69.5	23	13.5	12	69	42
178337	do	do	Jan. 31	387.4	228	69	24	13	13	68	42
178338	do	do	Feb. 1	400	224	72.5	24.5	14.5	11	69.5	40.5
178342	[Male]	do	do	400	229	70	23	13	12.5	68.5	43.5
178350	Male	Nankauri I., Nicobar Islands.	Feb. 8	400	229	73.5	23.5	13	12	67	43
178349	do	Trinkut I., Nicobar Islands	Feb. 3	381	206	66	24	14	11	66	42
178330	Female	Katchall I., Nicobar Islands.	Feb. 19	387.4	224	74	24.5	14	13	65	43
178334	do	do	do	400	222	71.5	24	13.5	12	63.5	42
178331	do	do	Feb. 20	393.7	227	67.5	23	13.5	13	66	41
178332	do	do	Feb. 21	387.4	225	64	23.5	14	11	66	44.5
178333	do	do	do	387.4	226	69	23	13.5	12	67	42
178335	do	do	Feb. 23	393.7	225	69	22	13	13	67	42
178339	do	Tillangchong I., Nicobar Islands.	Jan. 31	390.7	233	71	24	14	13	65.5	42
178340	do	do	Feb. 1	390.7	223	65.5	24.5	14	12.5	67.5	44
178341	do	do	do	419	226	69	24	13.5	12.5	66.5	41.5

[a] Measured in the flesh by the collector.

MEGAPODIUS NICOBARIENSIS ABBOTTI, new subspecies.[1]

Subspecific characters.—Similar to ***Megapodius nicobariensis nicobariensis***, but darker on both upper and lower parts, including the upper surface of the wings; the primaries particularly darker on outer webs, and with less contrast in color between the outer and inner vanes.

Description.—Type, adult male, No. 178343, U.S.N.M.; Little Nicobar Island, Nicobar Islands, February 28, 1901; Dr. W. L. Abbott. Pileum reddish cinnamon brown; cervix brownish olive; upper back olive brown, shading posteriorly to between Prout's brown and dresden brown on the upper tail-coverts; tail mummy brown verging toward Prout's brown; outer webs of primaries cinnamon brown; inner webs of primaries and secondaries sepia; outer webs of secondaries, and the greater coverts, of the same color as the tail; rest of the superior wing-coverts like the back; tertials similar to the rump, but a little more rufescent; sides of head, together with chin and upper throat, between hair brown and drab; sides of neck like the cervix; lower surface Saccardo's umber, posteriorly the feathers tipped with tawny olive; middle of breast and of abdomen tinged with slaty gray; lining of wing rather light dull sepia.

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[1] Named in honor of Dr. W. L. Abbott, who collected the type series.

Measurements.—Male[1]: Total length (in flesh), 381–387.4 (average, 385.3) mm.; wing, 215–230 (221); tail, 66–69.5 (67.2); exposed culmen, 23–24 (23.5); bill from anterior end of nostril, 14–14.5 (14.2); height of bill at base, 11–11.5 (11.2); tarsus, 69.5–71.5 (70.3); middle toe without claw, 42.5–44 (43).

Female[2]: Total length (in flesh), 374.6–387.4 (average, 381) mm.; wing, 215–223 (218); tail, 64–71.5 (67.2); exposed culmen, 22.5–23.5 (23); bill from anterior end of nostril, 13–13.5 (13.3); height of bill at base, 12–13 (12.3); tarsus, 65.5–67 (66.2); middle toe without claw, 41–44 (42).

Type-locality.—Little Nicobar Island, Nicobar Islands.

Geographic distribution.—Great Nicobar Island and Little Nicobar Island in the southern portion of the Nicobar Islands.

Remarks.—Specimens of this new subspecies have been seen from only the islands of Little Nicobar and Great Nicobar, but it may well be found also on other and smaller islands in the southern part of the Nicobar group. Birds from these two islands are identical.

Measurements of specimens examined are as follows:

Measurements of specimens of Megapodius nicobariensis abbotti.

[Collected by Dr. W. L. Abbott.]

U. S. N. M. No.	Sex.	Locality.	Date.	Total length.[2]	Wing.	Tail.	Exposed culmen.	Bill from anterior end of nostril.	Height of bill at base.	Tarsus.	Middle toe without claw.
			1901.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
178346	Male	Great Nicobar I., Nicobar Islands.	Mar. 8	381	215	66	23	14	11	70	42.5
178347	do	do	Mar. 18	387.4	230	66	23.5	14.5	11	71.5	44
178343	do	Little Nicobar I., Nicobar Islands.[3]	Feb. 28	387.4	218	69.5	24	14	11.5	69.5	42.5
178348	Female	Great Nicobar I., Nicobar Islands.	Mar. 12	374.6	216	66	22.5	13	12	65.5	41
178344	do	Little Nicobar I., Nicobar Islands.	Feb. 25	387.4	223	71.5	23	13.5	12	66	44
178345	do	do	Mar. 2	381	215	64	23.5	13.5	13	67	41

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[1] Three specimens, from Great Nicobar and Little Nicobar Islands.

[2] Measured in the flesh by the collector.

[3] Type.

NOTES ON SOME GENERA AND SPECIES OF CHALCID-FLIES BELONGING TO THE APHELININAE WITH DESCRIPTION OF A NEW SPECIES.

By A. B. Gahan,

Of the Bureau of Entomology, United States Department of Agriculture.

In attempting to place the species described below as new, some interesting facts were developed which it is believed will serve partially to clear up one or two mooted questions in the classification of the subfamily Aphelininae. Since these observations deal principally with the identity of a species lately shown to be parasitic on the Hessian fly, their publication at this time appears to be advisable.

Genus CENTRODORA Foerster.

Centrodora Foerster, Verh. naturh. Ver. preussisch. Rheinland, vol. 25, 1878, p. 66.

Paraphelinus Perkins, Bull. I, Hawaiian Sugar Plant. Assoc., 1906, p. 264.

The genus *Centrodora* was described in 1878 with *C. amoena* Foerster designated as the genotype. Both the genus and the species have apparently remained unrecognized since that time.

While examining specimens of *Paraphelinus speciosissimus* Girault the writer was impelled to compare them with the description of *C. amoena*, with the result that he is thoroughly convinced that Girault's species belongs to the genus *Centrodora* and is very likely synonymous with the type-species. The only point of disagreement between my specimens and the generic description of *Centrodora* is found in the reference to the postscutellum (Hinterschildchen) as completely covering the metanotum and reaching the base of the abdomen and this is explainable. A slide mounted specimen under poor illumination will easily give one an impression similar to that indicated by Foerster, due to the fact that the phragma is very conspicuous, resembling a greatly produced postscutellum. The probable correctness of this supposition can hardly be questioned, in view of the fact that the specific description of *amoena* agrees very closely with specimens of *speciosissimus*—so closely, in fact, as to make it seem highly probable that they are the same species. Practically all of the known European parasites of the Hessian fly are now known to occur in the United States, and there is no good reason why this

PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 55—NO. 2279.

species should not occur in both continents. The writer fully believes the two will eventually prove to be the same species, but it is probably advisable to retain the name *speciosissimus* for the American form until such time as European specimens can be obtained for comparison.

Another point of interest in this connection is the identity of *Agonioneurus locustarum* Giraud.[1] Howard[2] has pointed out the possibility that the species, the generic position of which has remained in doubt since the original description, may belong to *Paraphelinus*. The writer has carefully compared Giraud's description with that of *Centrodora amoena* by Foerster with the result that he is convinced that the two species are probably identical. The one point of disagreement seems to be in the presence or absence of the hairless streak on the forewing. Giraud specifically states that this line is absent in his species, but in view of the exact agreement in all other characters and in the light of the knowledge gained from the study of *speciosissimus* in which this line is narrow and inconspicuous lying for the most part in the infuscated portion of the wing, it seems practically certain that Giraud has overlooked it. The species name *locustarum* antedates *amoena*, and in case my conjectures are correct will supersede both *amoena* and *speciosissimus*.

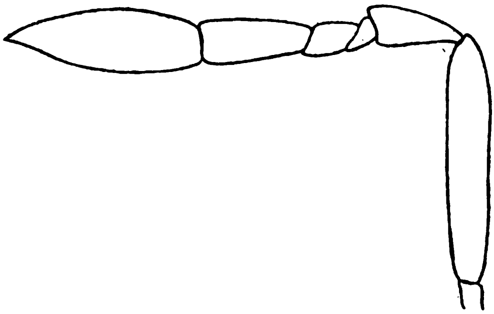

FIG. 1.—ANTENNA OF FEMALE (PARAPHELINUS) CENTRODORA SPECIOSISSIMUS GIRAULT.

The species *speciosissimus* unquestionably agrees with the description of *Paraphelinus* Perkins, and that genus therefore becomes a synonym of *Centrodora* Foerster.

Mr. Girault has stated his conviction that *Paraphelinus* and *Aphelinus* Dalman are synonyms.[3] If accepted this would make *Centrodora* also a synonym. Girault based his conclusion on the study of several Australian species which are unknown to the writer. As represented by *speciosissimus* the genus differs from *Aphelinus* in that the praescutum and scutellum are both divided by a median longitudinal groove, the wings are distinctly longer and narrower, with the venation attaining barely to the middle of its length; the legs are somewhat longer and more slender, the hind tibiae being decidedly longer than their femora; the ovipositor is more strongly exserted, and the scape of the male is distinctly though not greatly thickened. The antennae in both sexes are more elongate than in *Aphelinus* with the joints quite differently proportioned. The whole insect is more slender with a somewhat different habitus. These characters taken in conjunction with the difference in host relations make it extremely improbable that the two forms represent the same genus. It may be that a close study of many different species will show such an intergradation as to make it impossible to maintain the separation, but for the present, at least, it appears desirable to retain the name *Centrodora* as distinct from *Aphelinus*.

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[1] Verh. d. Zool.-Bot. Ges. Wien, vol. 18, 1868, p. 1278.

[2] Proc. Ent. Soc. Wash., vol. 16, 1914, pp. 81–82.

[3] Memoirs of the Queensland Museum, vol. 4, 1913, p. 180.

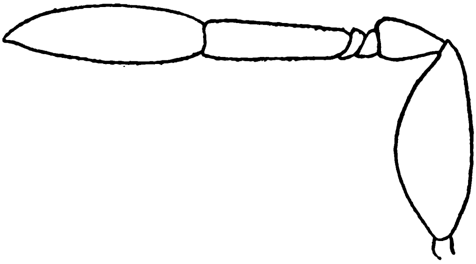

FIG. 2.—ANTENNA OF MALE (PARAPHELINUS) CENTRODORA SPECIOSISSIMUS GIRAULT.

Centrodora speciosissimus has been shown by McConnell to be parasitic in the puparia of *Mayetiola destructor* Say.[1] Girault has recorded it as parasitic in the eggs of *Xiphidium*, species ♀.[2]

(*Agonioneurus*) *Centrodora locustarum* was originally reared according to Giraud from eggs of *Xiphidium fuscum* Fabricius.

Foerster's type of the species *amoena* was collected on a window, as was also the type of *speciossissimus* Girault.

Genus TUMIDISCAPUS Girault.

This genus was originally based on a single male specimen mounted on a slide and now badly crushed. One antenna is however in good condition, and is illustrated in figure 3.

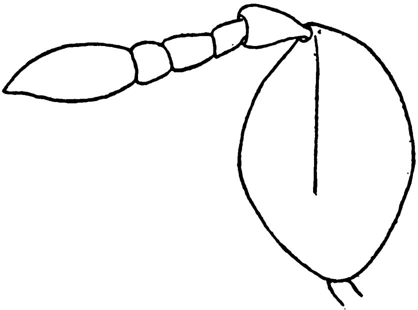

FIG. 3.—ANTENNA OF MALE TUMIDISCAPUS FLAVUS GIRAULT.

The writer has recently examined a number of specimens, including both sexes, which are in his opinion congeneric but represent a different species. These specimens are made the types of the new species described below.

Tumidiscapus, as represented by this new species, is very closely allied to *Centrodora*, both in structure and habits. The habitus is practically the same; the wings are elongate and narrow, the venation extending to the middle of the wing; the mesoscutum and scutellum are divided by a median longitudinal groove; the legs are long and rather slender; the abdomen of the female is elongate, acuminate at apex, with the ovipositor strongly exserted. It apparently differs from *Centrodora* principally in antennal characters, the female having the fourth joint longer than the fifth in both sexes and the male scape being much more greatly enlarged. These are probably only specific characters, and it is likely that the study of additional species will make it necessary to sink *Tumidiscapus* as a synonym of *Centrodora.*

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[1] Ann. Ent. Soc. Amer., vol. 9, p. 97.

[2] Ent. News, vol. 27, 1916, p. 405.

TUMIDISCAPUS ORTHOPTERAE, new species.

Except for the fact that the male scape appears to be much more greatly enlarged and flattened and the third antennal joint very slightly shorter, the male of this species seems to be exactly like the unique type of *T. flavus* Girault. Additional specimens may possibly prove them to be the same species.

Female.—Length 1.15 mm. Vertex granularly opaque, remainder of head and thorax very faintly microscopically sculptured, if at all; abdomen apparently smooth. Antennae 6-jointed, as follows: Scape, pedicel, 3-jointed funicle, and a solid club (figs. 4 and 5); the first funicle joint might be called a ring-joint, being smaller than the other joints, but somewhat longer than broad; its apex obliquely truncate, the upper margin shorter than the lower margin; the second funicle joint attached so as to form a distinct angle with the first; mandibles tridentate; parapsidal grooves deeply impressed, complete; praescutum with a weak median longitudinal groove; scutellum nearly circular with a weak median longitudinal groove; propodeum apparently with a strong median longitudinal carina probably due to the caving-in of the integument on each side of the middle in drying; forewing long and rather slender, extending considerably beyond the apex of the abdomen, its greatest length approximately three and one-half times its greatest breadth; marginal and submarginal veins equal, postmarginal absent, marginal cilia of forewing approximately one-fifth the greatest wing breadth, discal cilia moderately dense, nearly uniformly distributed except that the base of wing to the apex of submarginal is nearly bare, and there is a poorly defined nearly hairless oblique line extending from the stigmal vein backward and basad to the posterior wing-margin; hind wing long and narrow, the discal ciliation rather weak except a double row along the anterior margin, the longest marginal cilia a little longer than the wing breadth; legs slender; abdomen distinctly longer than the head and thorax, sessile, acuminate at apex, the

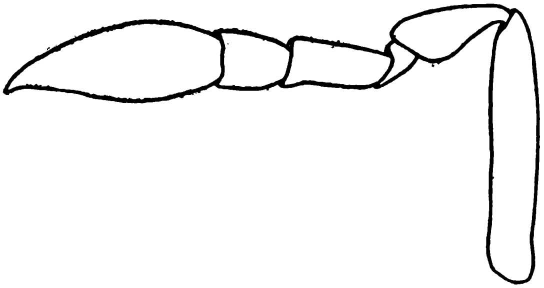

FIG. 4.—ANTENNA OF FEMALE TUMIDISCAPUS ORTHOPTERAE GAHAN.

ovipositor extending beyond the apex of abdomen fully half the length of abdomen. Color uniformly pale yellowish, the underside of head and thorax and the legs more pallid; antennae faintly infuscated, nearly concolorous with the head; wings hyaline; ovipositor sheaths fuscous.

Male.—Length, 0.75 m. Similar to the female, but the greatly enlarged scape, which is nearly as large as the head, is greatly flattened (at least in dead specimens) and very finely granularly opaque; the first funicle joint is apparently not obliquely truncate at apex, and the second and third funicle joints are subequal and approximately twice as long as broad.

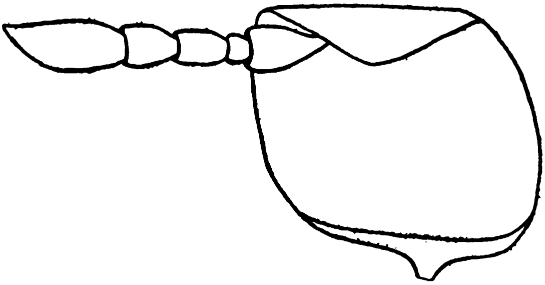

FIG. 5.—ANTENNA OF MALE TUMIDISCAPUS ORTHOPTERAE GAHAN.

Type-locality.—Titusville, Florida.

Type.—Cat. No. 21700, U.S.N.M.

Nineteen females and three males reared from the eggs of an orthoteron (*Locustidae*) deposited in the stems of grass, *Andropogon glomeratus.* Reared by Mr. G. G. Ainslie and recorded in the Bureau of Entomology under Webster No. 10844.

Type, allotype, and eight paratypes mounted in balsam. Twelve paratypes, including one male, mounted on card points.

EXPLORATION OF A PIT HOUSE VILLAGE AT LUNA, NEW MEXICO.

By Walter Hough,

Curator of Ethnology, United States National Museum.

While excavating a small stone house ruin at Stevens Cienaga, near Luna, New Mexico, in 1905, a circular pit was laid bare beneath the plaza. It was apparent that the pit had been filled with débris by the occupants of the stone houses and smoothed over to form a level dance place. This find led to the search for other evidence of pit structures. Several sites were discovered and were noted in Bulletin 35, Bureau of American Ethnology (pp. 59–64). All these sites except one were associated with stone houses; that one, a site at Luna, New Mexico, which appeared to be a village of pit dwellings pure and simple.[1] This site was discovered through the curious circumstance that the weeds grew higher in circular areas over a large tract of land, evidently due to greater moisture and fertility of certain spots, apparently buried pits. Although discovered in 1905 no work was done here till June, 1916, when a small grant from the Bureau of American Ethnology permitted a preliminary examination.

Permission to carry on archeological work on the Gila Forest Reserve was kindly granted the Smithsonian Institution by the United States Department of Agriculture. The land embracing the ruins has been filed upon by James Melvin Swap, of Luna, who generously approved of the work of excavation.

Topography.—The ruin occupies a gentle slope inclining south by east on the third terrace above the San Francisco River, which is about 1¼ miles away. The terrace abuts on low hillocks to the north. The area, about 30 acres in extent (see map), has been naturally forested since the abandonment of its use for human habitations, but a majority of the trees (pines) have matured and died or have been logged off. The soil is loose but is not washed, the only run-off being to the east and west of the tract. The eastern drain is a rivulet carrying permanent water from springs in high ground a few miles to the north. The field is smooth and is covered with dark loam about 1 foot thick. Below this is a yellow-brown clayey stratum somewhat sandy in places and about 5 or 6 feet thick. Below this the clay becomes gravelly. There are no rocks in the soil, which may be classed as lake shore alluvium covered with products of organic action on soil resulting in loam. In this soil there had been anciently dug perhaps 100 or more pits 14 feet in diameter and 5½ feet deep. Covering them were roofs of poles, boughs, and mud supported on posts, and the sides were perhaps wattled. It is evident that at a former time human activities had disturbed the contour of a large area by the removing and piling up of great quantities of earth. On the abandonment of this village, however, began the leveling forces of forest growth, wind, frost, and rain acting in concert to restore the surface to the smoothness which it presented when seen in 1907. At this time all traces of the pit-dwellings were obliterated, and they were only revealed, as mentioned, by the distribution of vegetation which grew higher in circular areas over the tract. The completeness of the work of the natural agencies is a matter for wonder. (See plate 28.)

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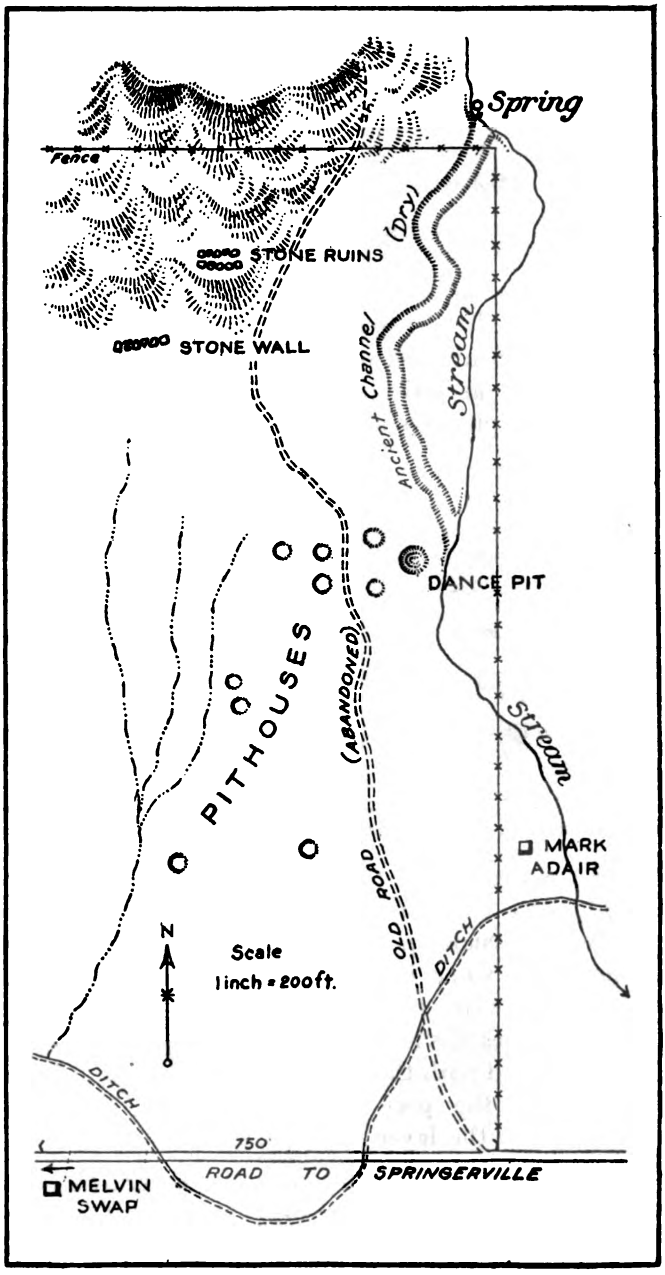
[1] Another site 7 miles north of Luna was discovered in 1917.

During the 11 years passed since the site was observed, the field, lying without fence, had been so trampled by cattle and dug up by prairie dogs that no signs of the pits were visible. Doubts even arose as to the validity of the former conclusions. Fortunately, however, the first excavations uncovered the side of a pit filled with soft earth.

Pit No. 1.—A trench was begun in made soil and prolonged until undisturbed earth was encountered, and this was followed around on the circumference of a circle 14 feet 7 inches in diameter. (Pl. 29.) The earth within this circle was then carefully removed and all artifacts, bones of animals, etc., sorted out during the process. Information on the construction of the pit house soon was supplied by charred remains of posts and burnt clay bearing impressions of roof structure. The soil filling the pits is dark and rich, and contains charcoal, ashes, bones of animals, hand stones, whetstones, cores, bruising hammers, flakes, fragments of pottery, etc.

A large grooved hammer was found. An irregular metate was observed at the 4-foot-6-inch level, and this stone was probably raised a foot from the floor. (Pl. 30.) The metate was rude and not deeply worn. Near the metate was encountered a smooth stone slab with rounded corners and edges, probably a bread-mixing slab. A small mortar, consisting of a cavity in an irregular stone, was taken out. Two feet from the center of the pit and near the metate was a bed of ashes, indicating the fireplace. A burial of an infant was found in the west wall, accompanied with a roundel ground from a piece of pottery and a fragment of a pottery vessel. Also on the west side, at a depth of 3 feet, there occurred a vase with broad handle containing white potter's clay. (Fig. 32.) There was a large recess on the west wall packed with débris. On the east side of the pit there was uncovered a bench 18 inches high and approximately 36 inches wide cut in the soil. In the center of the pit was a hole 20 inches deep, probably for the center post. The floor of the pit was yellow



MAP OF REGION STUDIED.

natural earth with thin layers of packed black earth, indicating the floor level.

Pit No. 2.—Twenty-five feet southeast of pit No. 1 there was opened a pit 63 inches deep and 12 feet in diameter. On the west side was observed an earth bench 6 inches in height, and at the floor level near the southeast wall a hole 27 inches deep and 12 inches in diameter. (Fig. 1.) On the floor near the center of the pit lay a mealing stone and adjoining it a fireplace. Remains of posts (pl. 31), some fragments of baked roofing mud, hand stones, and animal bones were found in this pit.

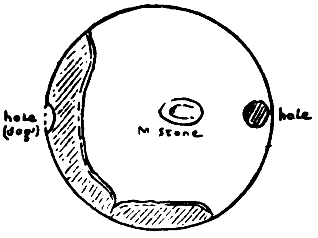


Fig. 1.—Ground plan of pit.

Mealing house.—Southwest of pit No. 2 was unearthed a mealing house, 12 feet square, as indicated by charred remains of corner posts. This shed, like the pit houses, had been roofed with mud. It contained 6 to 8 metates, one of them mounted on three rounded stones (fig. 2), and many hand stones, rubbing stones, slabs, etc. Fragments of nine large coarse pottery jars and several bowls were interspersed among the stone implements. There were here several burnt clay hearths and much charcoal mixed with the soil. (Fig. 3.) All the specimens were found in the layer of surface loam somewhat more than a foot under the ground. The loam which is about a foot deep becomes very hard when dry and breaks into cubes during drought. The structure unearthed here was an open-air shed, mud covered, in which grinding and cooking was done as in the similar sheds of the Pima-Papago. (Fig. 4.)

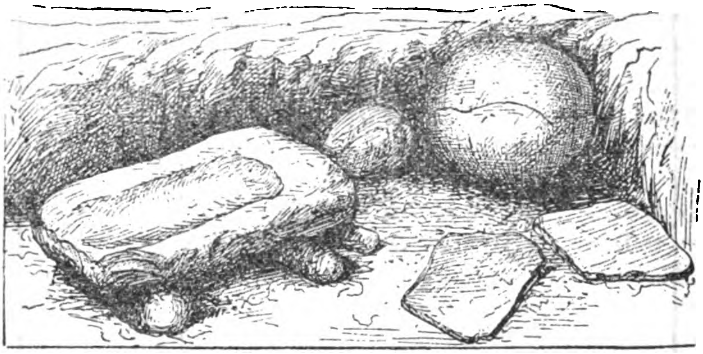


Fig. 2.—Objects in place in mealing house. (From a sketch by the author.)

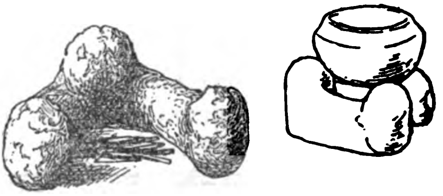


Fig. 3.—Clay hearth and method of use.

Cemetery of infants.—Southeast of and near pit No. 1 was a cemetery in which infants alone were buried. There were hearths of burnt clay in this cemetery like those in the ruin at Stevens Cienaga.[1] Four or five burials were encountered, and these were accompanied with pottery of small size but interesting in form and decoration. With the body of a child of about 5 years had been placed a flint scraper and some bones of deer. On the border of the cemetery there were taken out, at a depth of about 5 feet, hearthstones with charcoal lying upon them and mealing stones. Many large bones of animals cracked to obtain the marrow were found in the débris. Some of the bones are burnt.

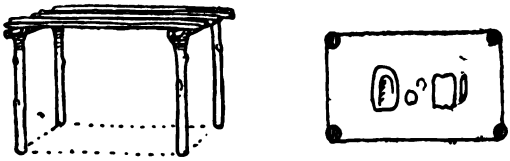


FIG. 4.—PLAN AND ELEVATION OF MEALING HOUSE.

Pit No. 3.—A section of this pit was opened and the wall was seen to be well defined. On the floor lay a metate and a wedge-shape stone of equal dimensions, probably a rest for inclining the metate. Here were a number of hammer stones, pottery fragments, bones, etc.

Pit No. 4.—This pit was completely opened out. (Pl. 32.) It is 12 feet in diameter. As noted in other pits, there was a deep hole sunk in the floor on the west. There was a metate in place, and in the course of the excavation mealing stones, whetstones, and fragments of decorated pottery were removed.

Mealing house No. 2.—Adjoining pit No. 4 a cooking or mealing house was excavated. It yielded a globose vessel of thin gray pottery tolerably well decorated and furnished with pierced lugs (see fig. 38) and many fragments of large coarse, black pottery vessels. There were found many stones and hammers and animal bones. Some pieces of infants' skulls were seen, but not as formal burials.

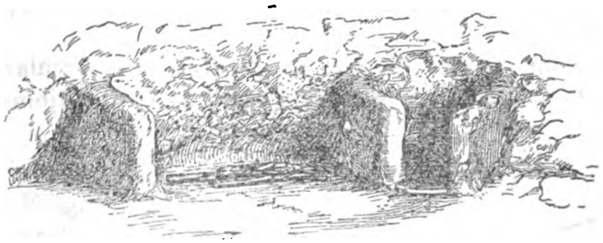


FIG. 5.—FIREPLACE WITH CLAY JAMBS.

Pit No. 5.—Eight feet northwest of pits Nos. 1 and 2 a pit 42 inches deep was opened. From the evidence of the action of fire this pit was called the fire pit. A great fireplace was set against the west wall and flanked on either side with a rounded jamb of burnt clay. (Fig. 5.) The west wall was deeply burnt between the jambs, and on the hearth, which was level with the floor, lay much ashes, charcoal, and remains of charred posts. (Fig. 6.) Adjoining was a smaller fireplace having a smooth hearth and a bottom slab in form of a tablet with rounded corners and edge, probably a baking slab. (Pl. 33.) Beyond the smaller fireplace lay a great mass of burnt roof clay, rendering it evident, in connection with the charred beams, that the pit structure was destroyed by fire. On the floor of this pit lay two metates, a grooved maul, and other stone implements, as well as fragments of pottery.

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[1] Bulletin 35, Bureau of American Ethnology, 1907, p. 63.

Pit No. 6.—Sixty-six feet north of pit No. 2 a pit was cleared. In it were found a number of regularly worked and irregular metates, and near them hand stones, stone hammers, and fragments of rough pottery. The hearth in this pit was formed of many stones of equal size laid as pavement on the floor of the house, and upon the hearth was a layer of gray wood ashes.

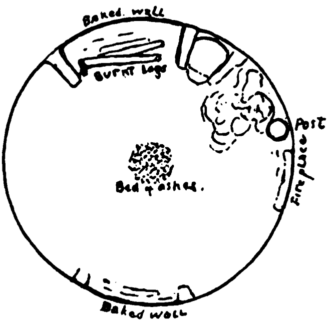

FIG. 6.—GROUND PLAN OF FIRE PIT.

Pit No. 7.—This pit contained the customary metates, hand stones, etc. At the floor level on the east side is a hole 3 feet deep. A cache of bright yellow paint was discovered under the earth-bench, and a small lot of obsidian nodules was found hidden in a hole in the wall. There were many animal bones, fragments of pottery, and chips of hard stone. A mass of chips fallen from the stone-workers' hands were found in a little heap. A pottery spindle-whorl and two bone awls were taken out. The pit was 4 feet deep and 14 feet in diameter.

Great dance pit.—Southeast of pit No. 2, 108 feet, is a circular concavity 84 feet in diameter and 5 feet deep. (Pl. 34.) It adjoins the bank of a former channel of the small permanent watercourse east of the village site. The margin of the pit fades off into the general land level, but is eroded slightly on the north and east. A pine tree 9 feet in circumference stands on the south rim, and remains of dead trees cover the northeast section of the rim. The earth in the pit is hard-packed loam containing fragments of charcoal. In exploring this pit a trench was cut from the center to the circumference on an east-and-west line, following the bottom contour as shown by the unmodified earth. (Fig. 7.) Beginning at the edge

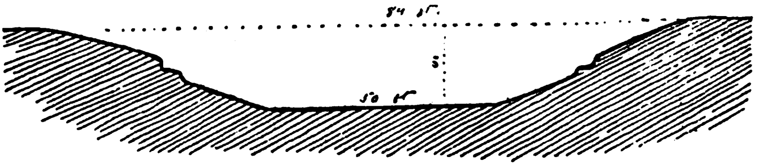

FIG. 7.—SECTION OF GREAT DANCE PIT.

there is a slope of 25 feet to a set-off 16 inches high, apparently the back of a bench 4 feet wide. The depth here is 31 inches from the surface of the deposit in the pit. From this bench the ground slopes about 12 to 16 feet and merges into the level floor of the pit. The deposit here is 50 inches deep. There was thus a circular floor for dance purposes, about 50 feet in diameter, with 196 feet of bench around it for spectators. This amphitheater pit, approximately 265 feet in circumference and nearly 10 feet deep, was probably surrounded with a palisade. It will be seen that the earth deposit in the pit (50 inches) is about that which levels the pit houses, but the great pit being 10 feet deep is not filled, and hence it is the only surviving landmark of the ancient village. The labor of excavating the great dance pit or kiva was great, and the work seems to show that the population of Pit Village was large enough to furnish a good force of willing hands. As no tools of stone for digging were found, it appears probable that the excavation was made with digging sticks and the earth removed in skin bundles.

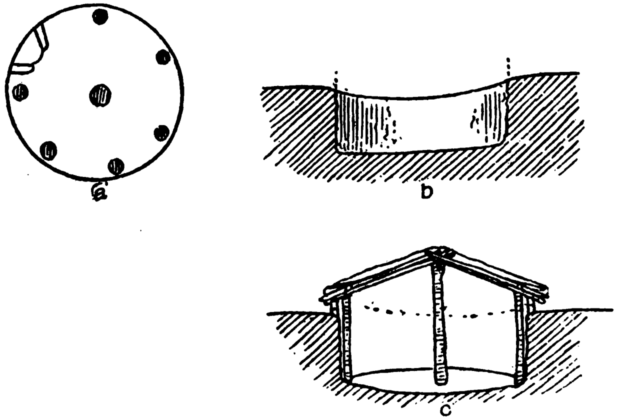

FIG. 8.—PLAN AND SECTIONS SHOWING CONSTRUCTION OF PIT HOUSES.

Enough has been learned through the tentative exploration to enable us to essay a restoration of the pit village as it may have appeared centuries ago. The data shows that the excavation and the added height given by the removed earth would be about 8 feet, leaving thus 3 feet of the house above ground. The roof would be supported on eight posts about 10 feet long. The sides of the house above ground would be wattle and daub, or wattled and banked with earth. (Fig. 8, *a*, *b*, *c*.) Judging by the height of the earth embankment thrown up in the excavation of the pits during the present work, the measurements suggested, as well as the banking, seem plausible. It would be easy thus for the Indian to walk up on his roof and descend through a hatchway by means of a notched ladder as used by the Pueblos. The appearance of the cluster of houses forming the village would be that of circular mounds interspersed with rectangular open-air sheds and on the margin of the village a pallisaded dance circle. (Pl. 35.)

ARTIFACTS.

Mealing stone.—Turtle-shape stone of coarse volcanic grit for use as a mano. The working face of the stone is flat from side to side and ground to the arc of a circle about 12 inches in diameter from end to end, showing that it was used in a basin-like metate like those found at Luna. It belongs to the pillow type of mano found south of the mountains and in California. North of the mountains the mano is usually worn to a triangular section from use on a flat, steeply inclined metate, as among the existing Pueblos. Quite frequently the pillow-shaped mano is grooved along the sides for the finger grip. (Fig. 9, No. 292113, U.S.N.M.); 4¾ inches wide, 6¾ inches long, 1½ inches thick.

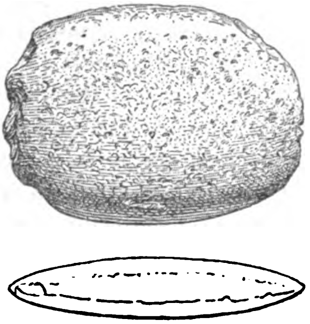
FIG. 9.—MEALING STONE AND SECTION.

Metates.—As remarked, every pit house revealed on excavation a mealing stone lying on the floor near the fire and in the open-air sheds a number were taken out. Sometimes an irregular stone had been used with almost no shaping (fig. 10); again the stone was roughly pecked to shape (figs. 11, 12); a little more work was put on some specimens (figs. 13, 14); but in no case were the metates finished to a definite form as among the Pueblos. Two specimens display a specially worn area near one end like specimens from northern Arizona and Utah. (Figs. 15, 16.) Metates in the pit houses were propped up at the required slant on a wedge-shape stone which had been selected for its shape. (Figs. 17, 18.) In the sheds they were sometimes set up on three stones. (See fig. 2.) The metates found are of gray grit stone and were nearly all broken in place or cracked to pieces on removal into the air.

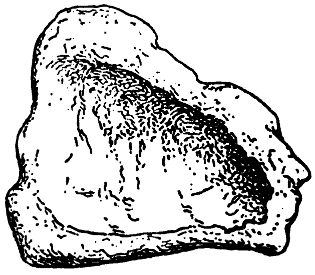
FIG. 10.—IRREGULAR MEALING STONE.

Paint grinding (?) stone.—Small oval slab of fine grit stone, flat below and concave above, the concavity smoothly worn. Suggests the stones used by the Zuñi and other Pueblos for grinding paint, numbers of which are exhibited in the halls of archeology. The use to which this specimen was put is not known. Only this one was found (fig. 19, No. 292087, U.S.N.M.); 2¾ inches wide, 3½ inches long, ¾ inch thick.

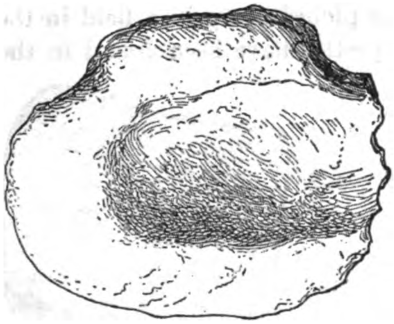

FIG. 11.—MEALING STONE PARTLY PECKED.

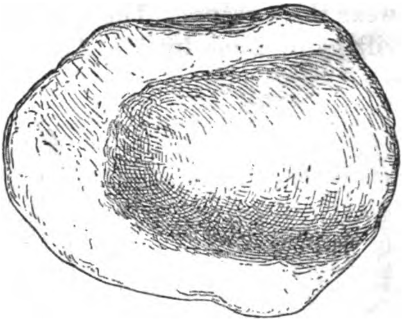

FIG. 12.—MEALING STONE PARTLY PECKED.

Mortars.—The mortars from this site consist of large, rough slabs of stone having a small cavity worked in the flat side. The cavities are smooth and regular. (Figs. 20, 21.) No pestles were found in the site, but the specimen found on a neighboring field may be taken as the type. (Fig. 22.) It has been suggested that the small mortars were used for bruising roots and extracting the fiber from yucca and agave leaves.[1]

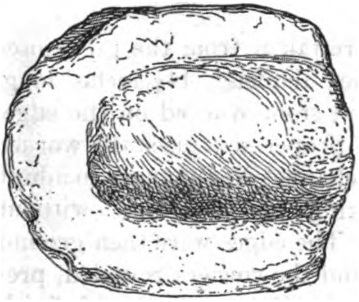

FIG. 13.—MEALING STONE WORKED TO SHAPE.

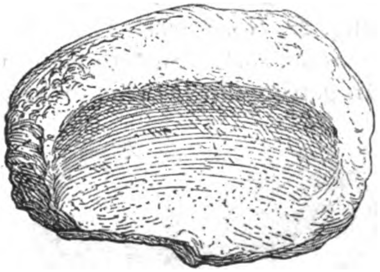

FIG 14. MEALING STONE WORKED TO SHAPE.

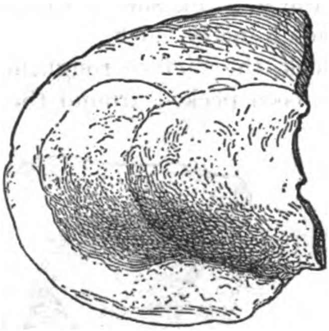

FIG. 15.—MEALING STONE WITH POCKET CAVITY.

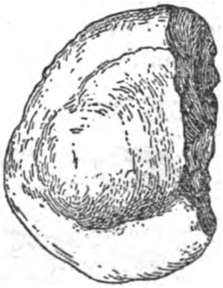

FIG. 16.—MEALING STONE WITH POCKET CAVITY.

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[1] Bulletin 87, U. S. National Museum, p. 15.

Pestle.—Of gray green sonorous stone, scarcely showing at this interval traces of the methods by which it was fashioned or of its wear through use. The specimen was ploughed up in a field in the village of Luna by Mr. Adair. No pestles have been found in the pit village, but small mortar stones were taken from the pit houses (fig. 22, No. 300094, U.S.N.M.); 2 inches diameter, 14¼ inches long.

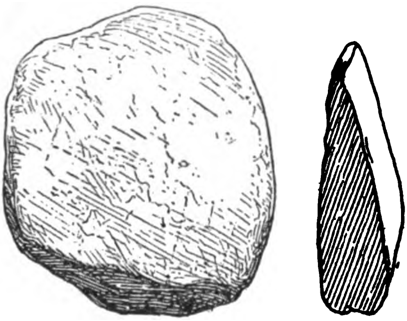
FIG. 17.—WEDGE SHAPE STONE FOR PROPPING METATE AND SECTION.

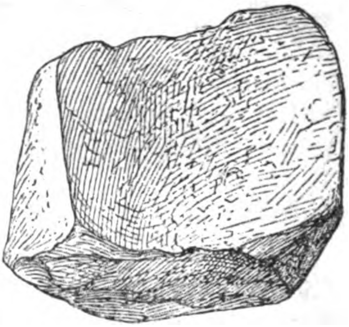
FIG. 18.—WEDGE OF STONE FOR PROPPING METATE.

Stone slab.—Smooth slab of blackened stone worked on the edge. In getting out the slab or in securing a proper size piece the worker scored a channel deep enough to admit of breaking the stone off without flawing. The edges were then ground smooth and the corners rounded, precisely as the Zuñi quarry and finish their baking slabs. The specimen formed the bottom of the smaller fireplace in the fire pit (fig. 23). (See fig. 5.) Other slabs were found in the mealing sheds (figs. 24, 25, No. 292120, U.S.N.M.); 14 by 15 inches, 5 inches thick.

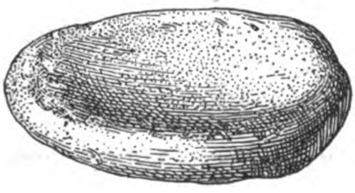
FIG. 19.—STONE FOR GRINDING PAINT

Stone hammer.—Coarse basaltic rock, the surface roughened and pitted from age. A deep groove has been pecked around the stone, except where the hafting touched, dividing it into two equal lobes. One face of the hammer is squarish, the other spalled by working. A few of these hammers were observed, the common type being nodu-

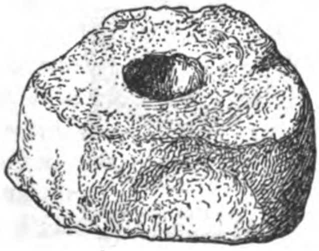
FIG. 20.—SMALL MORTAR IN STONE BLOCK.

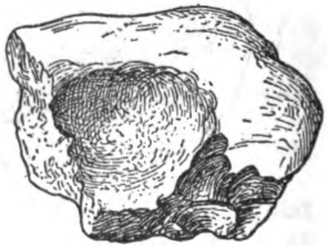
FIG. 21.—BROKEN MORTAR.

lar of chalcedony or other hard stone (fig. 26, No. 300093, U.S.N.M.); 6 inches long, 3½ inches diameter.

Hammer stones.—Water-worn quartz pebble showing several bruised areas, due to work in hammering. This specimen is a good example of the selection of a naturally formed stone for a particular use (292099); 2¼ inches in diameter. Another of brown grit stone bears evidence of use as a hammer and rubbing stone (292099); 3½ by 3 by 2 inches. The utility hammer, however, of this site begins as a block of chalcedony, often having one face showing the curve of the parent formation. This block from use becomes rounded and smaller until when comparatively smooth is discarded or employed in minor work, as in the case of a pebble just picked up for the occasion. In this way numerous hammers gather about a long-inhabited site and superficially give an indication of numerous workers. Observations among the Hopi prove that a hammer stone is useful for working stone only while its facets are sharp. The hammer is then given a chisel effect rather than a bruising effect (292098, U.S.N.M.); 2½ inches in diameter.

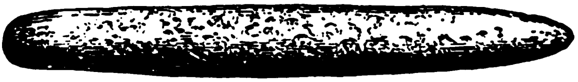
FIG. 22.—PESTLE OF GREEN STONE.

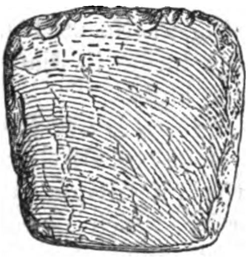
FIG. 23.—SMOOTH STONE SLAB FORMING A HEARTH.

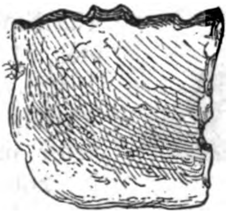
FIG. 24.—FRAGMENT OF SMOOTH STONE SLAB.

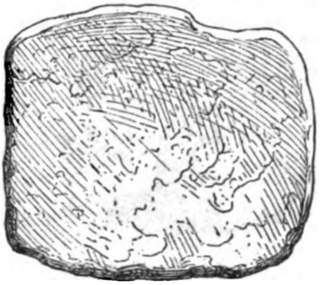
FIG. 25.—STONE SLAB FROM MEALING SHED.

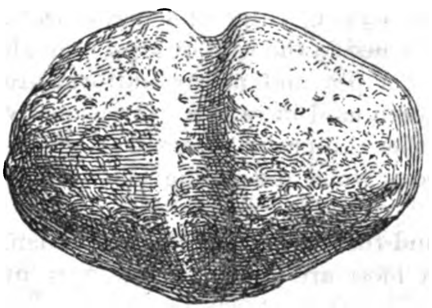
FIG. 26.—GROOVED STONE HAMMER.

Abrading stones.—Irregular pieces of brown grit stone showing use of abrading were relatively frequent in the pit-house débris. Some of them have flat working surfaces, but many of them have been reduced by use to nondescript shapes, as though by employment in shaping wood. Grit stone is scarce in this region, and pieces of it were no doubt prized by the pit-house people. They did not have the grooved arrow-shaping tools so common on other sites throughout the Southwest. (292118, U.S.N.M.)

Lava rasp.—Several pieces of worked vesicular black lava found give evidence of their use as a rasp, probably for currying hides in the process of tanning. One piece, nearly square, is of convenient size for holding in the hand; another is ovate and has a small cavity on either side for a finger grip (292021, 292115, U.S.N.M.); 4 inches square, 2 inches thick, 4 by 3 inches square, 2¾ inches thick.

Pot rest or andiron.—A number of stones, conical in shape, apparently not worked but selected for the practical utility of their form, were seen in the débris of the open-air sheds. In one instance they acted as supports for the metate, but mostly they were associated with fireplaces and evidently employed as primitive andirons. They answer for the formed clay bosses on the triangular hearths discovered in several places in this region (fig. 27, No. 292104, U.S.N.M.); 4 inches in diameter, 3¾ inches high.

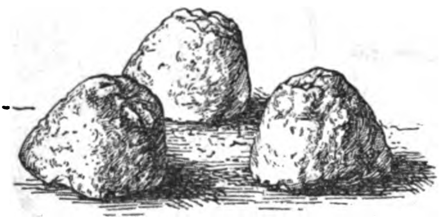

FIG. 27.—PRIMITIVE ANDIRONS.

Minor stonework.—The scarcity of stones of all character on the pit-village site is noteworthy. Such small worked objects and refuse as occur are select material brought in from the surrounding region. Most plentiful are masses and chips of banded chalcedony, which occur in rosette and bulb forms generally here. It was used for hammers, cutting chips, etc., but could not be worked into arrowheads. A variety of chalcedony almost ruby color worked better and was evidently prized. Obsidian nodules were collected from some source and brought to the site for use as cutting chips and arrowheads. Three of such nodules were found cached in the wall of a pit. Small obsidian nodules about the size of a pea and nearly uniform are somewhat frequent and may have been used in rattles. Occasionally a small quartz crystal is found. Other chippeable stones are a greenish basalt and a black homogeneous stone resembling chert. The paucity of materials is striking.

Arrowheads.—These are small and the majority of black obsidian. Some of them are well made, but most are rude. A few were of milky chalcedony.

Scraper or knife.—Not often do the chips show evidence of use or rechipping. A small tablet of chalcedony has a chipped edge and may have been used in cutting or scraping. One milky chalcedony specimen has the ovate scraper form, which may or may not be intentional.

Pendant.—Thin tablet of light-brown, fine-grain stone, smooth on one side and covered with vertical grooving on the other. Two holes are drilled near the edge for suspension. This is one of the two examples of the working of stone for ornament from this locality. (Fig. 28, No. 292069, U.S.N.M.) Found in the débris of a pit; $1\frac{5}{8}$ inches long, $1\frac{1}{2}$ inches wide, $\frac{3}{16}$ inch thick.

Fetish.—Of limestone carved in the form of a bear. Through the body is drilled a hole for the suspension of the fetish by means of a string. The specimen exhibits a marked appreciation of form on the part of the maker and considerable skill in carving. The work was done with Stone Age tools, marks of whose action are still apparent. The specimen represent a higher stage of art than was anticipated from the crude character of other artifacts gathered here. Found on the surface. (Fig. 29, No. 292092, U.S.N.M.)

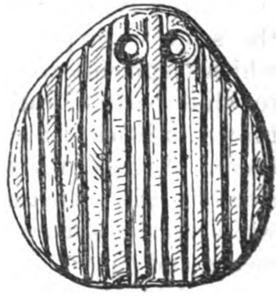

FIG. 28.—CARVED STONE PENDANT.

Pigment minerals.—Most prevalent of paint stones at Luna were stream bowlders of dense white limestone. These show surfaces which have been planed away by grinding on another stone to produce white paint for body decoration or other purposes not connected with pottery, in which case white clay was used. (292116, U.S.N.M.)

Red ochre paint was not observed on the site, but a brilliant deep yellow ochre was somewhat frequently found. A mass of this color was stored in a small pot, and several masses were found under an earth bench in a pit apparently secreted there. Copper pigment, common among southwestern tribes ancient and modern, was not seen and its absence is worthy of notice.

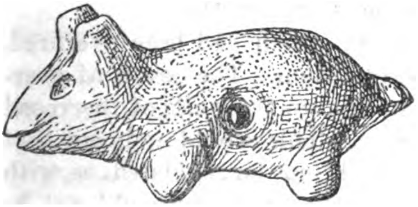

FIG. 29.—FETISH CARVED FROM LIMESTONE.

Shell.—Three fragments of a shell bracelet and one tubular shell bead were found after a thorough search. They were in the surface débris and hence may have been derived from some other source. (300082, 300083, 292070, U.S.N.M.)

Bone.—Prongs of deer antlers, one quite smooth at the point, and tips of antlers were observed. They were generally broken off and in one case cut off with a rough-edged stone. (300089, 300088, 292095, U.S.N.M.)

Two sections of ribs which show use probably as knives were found; also the unworked spinous rib of an animal (300090, 292095, U.S.N.M.) About a dozen awls were taken from the débris in various pit dwellings. They are mostly of the fibula of the deer. In one specimen the head of the bone has been worked down and grooved around the shaft. Some of the awls had been burnt. The points are usually short and the implements sometimes worn down to a short stub (300087, 292071, 292072, U.S.N.M.); 2½ to 5 inches long.

Pottery.—The prevailing pottery represented by fragments in the soil over the pit villages is coarse, brown, fragile ware, with unpolished surface. This was the characteristic common ware made from the local clay underlying the site. In the débris occur fragments of the same ware polished and better finished. Decorated ware, of which fragments are very few relative to the brown, has a dark gray to white paste of rather good quality, washed with white and with brown to black decoration. This clay was brought from some distance. A mass of it was found in a wide-handled vase placed in the side of a pit. Another variety of coarse, brown paste washed with white and decorated with red brown, is represented by two fragments, and only one fragment of red ware was seen. All-coiled ware does not occur, and coiling is only seen as a decoration on the necks of vessels. (See fig. 31.) Fillet rims so prevalent on the Blue and in other southern locations is not found. Incised decoration is present only on one specimen. (See fig. 39.)

Forms.—The bowl is the commonest form and is generally from small to medium size (figs. 35, 36, 37); small vases (figs. 39, 41); large vases of a rude form (fig. 30) and more furnished like those of Blue River with coiling pattern around the neck (fig. 33); vases with handles either a loop for the finger or a projection for lifting (figs. 33, 34); bird-form vases (figs. 42, 43); and globular vases with painted decoration and with bosses (figs. 38, 41).

Pottery firing.—Fragments of pottery which had been overfired, even melted, came to light in the exploration. The result of overfiring with the clays used here was to thicken the walls of the vessel by production of vesicles in the paste. This would indicate that the pottery was baked in a fire that could not be regulated, as with large wood or with material whose heating capacity could not be gauged, as with masses of rabbit brush, which burns quickly, producing great heat.

Decoration.—In all cases the decoration has been applied with an unskilled hand, and there is lacking the clear-cut line that the ancient Pueblo potter was accustomed to produce. The prevalent decoration was in bands of parallel lines or straight lines. Angled zigzag lines and serrations are frequent. In a few cases whorls are noticed, and very rarely the interlocking fret. Several fragments were found which gave a tantalizing glimpse at realistic drawing. One of these shows the head, right arm, and left hand of a man, the drawing occupying an area in the hollow of a bowl decorated around the border with bands curved with diagonal zigzag lines, probably snakes. Another shows the body of a deer, another mountain sheep, and still another numerous stars represented by crosses. (Pl. 36.) The style of work resembles that of a bowl found at Linden, Arizona, in the White Mountains.[1]

Figurines.—Burnt-clay figurines of animals are quite characteristic of the ruins in this particular region. They are found scattered through the village débris, and they have not been discovered in a definite plan of deposit, so that their meaning or use could be determined.[2] The pit village site yielded one of these objects found on the surface, where it may have been derived from some other ruin. An animal figurine carved from white limestone was also found on the site and appears to be a relic of the pit-dweller people. It is a realistic carving representing a bear remarkably well executed. A hole is drilled through the figurine for the passage of a cord and the object is a fetish. It may be regarded as the highest example of pit-dweller art, if in reality it belongs to this group. (See fig. 29.)

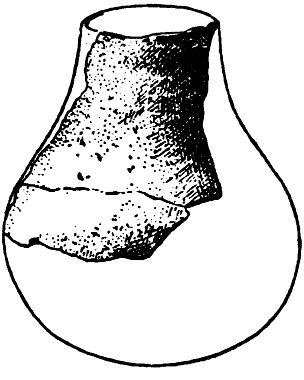

FIG. 30.—LARGE BROWN WATER VASE.

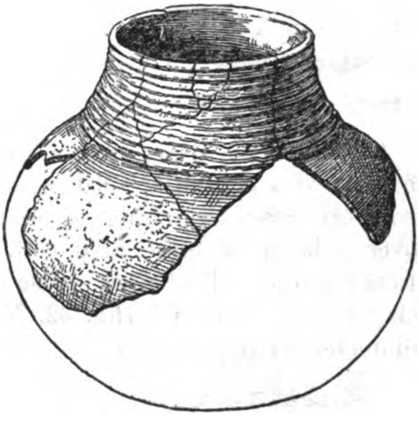

FIG. 31.—VASE WITH COILED NECK.

Pottery polishing stones.—Three pottery polishing stones were found on the site. One is black (a very hard stone taking a high polish) and one a quartz pebble with mirror polish on one face. Evidence from the pottery shows that the surface finish was not carefully executed. (292095, U.S.N.M.)

Fragment of large water vase.—Light-brown ware, irregular surface, not smoothed carefully, and showing no polish. The paste is characteristic of the local clay. The form of the vessel is rude and is reminiscent of a potter not an adept, resembling the sporadic Apache or Navaho clay vessels. Restored from fragments found in a mealing shed (fig. 30, No. 292065, U.S.N.M.); 13 inches in diameter, 16 inches high.

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[1] First Museum—Gates Expedition. Ann. Rep. U. S. Nat. Mus., 1901, pl. 19.

[2] Hough, Bulletin 87, United States National Musuem, p. 116.

Large water vase.—Globular body, smooth, dark brown to black. Neck portion coiled. In most respects this vessel is like those of the Blue and of the neighboring sites about Luna. Restored from fragments found in a mealing house (fig. 31, No. 292066, U.S.N.M.); 16 inches in diameter and 16 inches high.

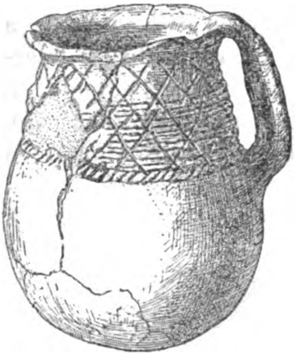

FIG. 32.—CRUDE HANDLED JAR.

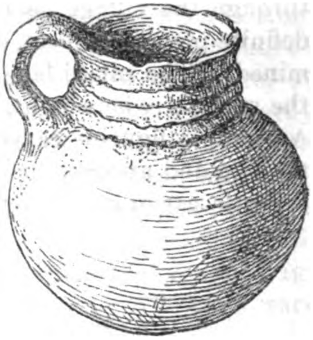

FIG. 33.—SMALL HANDLED VASE.

Handled jar.—Dark brown body, thickly worked; broad handle formed of a bundle of cords of clay pressed together and decorated with crisscross scratching. Collar of vessel treated in the same way over a band of imbricated coil. This extremely rude vessel was found in the wall of a pit house and was partially filled with white clay when discovered (fig. 32, No. 292032, U.S.N.M.); 6 inches in diameter, 9½ inches high.

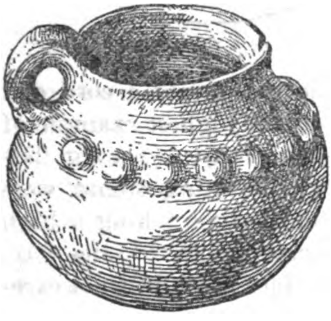

FIG. 34.—CUP WITH BOSSES.

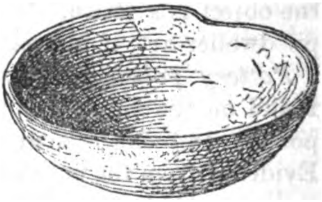

FIG. 35.—BOWL WITH JOGGED RIM.

Handled vase.—Brown paste, smooth body, neck with coil ornament, small handle. The vessel is crudely finished (fig. 33, No. 292041, U.S.N.M.). From a child's burial; 4¾ inches in diameter, 4½ inches high.

Cup.—Almost black paste crudely worked; small handle sufficient for the insertion of one finger. On the shoulder is a row of small bosses formed by punching out the green paste from the inside. This decoration is more often employed in southern than in northern pottery.[1] Among the living Pueblos it is common in Zuni cooking ware,[2] to which the vessel described has a resemblance. (Fig. 34, No. 292045, U.S.N.M.) From a child burial.

Small bowl.—Dark-brown ware with smooth interior and rather irregular exterior. The vessel is unique in having a jog in the rim intentionally worked. From a child's burial. (Fig. 35, No. 292036, U.S.N.M.)

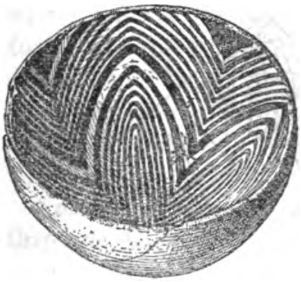

FIG. 36.—BOWL WITH QUATREFOIL DESIGN.

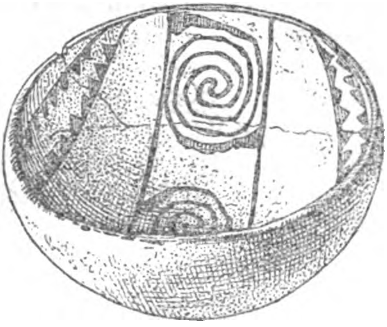

FIG. 37.—WHITE BOWL FROM CHILD'S GRAVE.

Bowl.—Brown paste, plain on exterior, washed with white on the interior and decorated in brown. The design is a quatrefoil occupying the center with triangular sections reaching down between the arms. The pattern is heavily gradined (fig. 36, No. 292051, U.S.N.M.); 7¼ inches in diameter, 4 inches high.

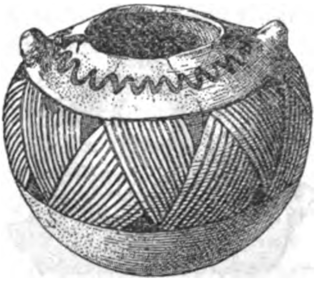

FIG. 38.—INCURVED BOWL WITH LUGS.

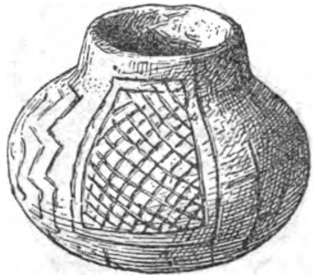

FIG. 39.—SMALL INCISED VASE.

Bowl.—White paste, probably not washed with white. Decoration in black design, embraced in a band passing across the middle of the bowl and two lanceolate sections flanking it on either side. The middle band has three rudely drawn whorls (introducing bird). This arrangement of the field of the bowl is very unusual. (Fig. 37, No. 292044, U.S.N.M.) From the burial of a child; 5½ inches in diameter, 2½ inches high.

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[1] Fewkes. Two Summers' Work in Pueblo Ruins, 22d Ann. Rep. Bur. Amer. Eth., pt. 1, p. 189.

[2] See collections exhibited in the Natural History Building, United States National Museum.

Incurved bowl with lugs.—Homogeneous white paste thinly worked. Two lugs are formed on either side of the mouth of the vase; these are pierced and are like those on ancient globular canteens. The decoration is a zigzag line rudely drawn around the rim and a band of interlocking triangles gradined. Although of good materials, the vessel is rudely executed and the design hesitatingly drawn. Decoration in dark brown. Found in a mealing shed (fig. 38, No. 292049, U.S.N.M.); 8 inches in diameter, 6 inches high.

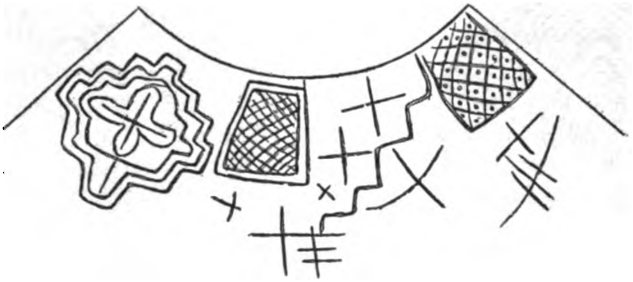

FIG. 40.—DECORATION ON INCISED VASE.

Small incised vase.—Brown to dark brown paste, not well finished; surface and bottom decorated with incised designs scratched in the clay while soft. (Fig. 39, 40, No. 292038, U.S.N.M.) From a child's burial; 3 inches diameter, 2½ inches high.

Bottle-form vase.—Small gray vase with handle. On the neck equidistant from the handle are two projections painted with black rings, probably to indicate eyes, and on the shoulder are three bosses, also painted with a design which forms part of a bird scroll. The body is encircled with a band of interlocking bird convention. The backs of the birds are dentated to indicate plumage, and streaks across the line of the scroll above are of the same meaning. (Fig. 41, No. 292037, U.S.N.M.) The ware is light and the form good, but the decoration is halting; 3 inches in diameter, 3½ inches high.

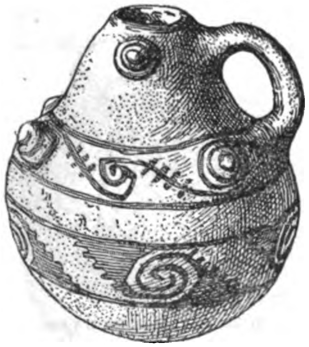

FIG. 41.—BOTTLE-FORM VASE.

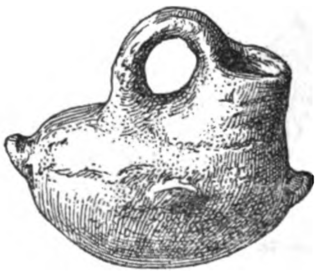

FIG. 42.—BIRD-FORM VASE.

Bird-form vase.—Brown paste, rough surface; loop handle; tail, wings, and breast represented by projections. Rude as this small vessel is in finish, it shows fundamentally a good conception of form. It was designed as an offering. (Fig. 42, No. 292040, U.S.N.M.) Length, 3 inches; width, 2¾ inches; height, 2¾ inches.

Bird-form vase.—Gray body worked with white and decorated in black. The decoration consists of horizontal lines around the neck; zigzag lines on the handle; and plumage, wing, and tail conventions forming a band around the body. The wing convention which seems to express the folding of the bird's wing is new, as far as the writer knows. This little vessel, in spite of its obvious crudities in form and execution, shows a considerable advance in symbolic decoration. It is more related to the art of Blue River than to other examples from the locality where it was found. (Fig. 43, No. 292039, U.S.N.M.) From a child's burial; 2½ inches long, 2 inches wide, 2½ inches high.

Spindle whorl.—Disk of decorated pottery having a hole drilled through the center. The vessel from which the disk was made bore a recticulate decoration (fig. 44, No. 292062, U.S.N.M.); 2 inches in diameter.

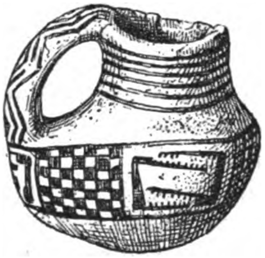

FIG. 43.—BIRD-FORM VASE.

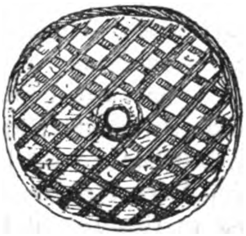

FIG. 44.—SPINDLE WHORL WORKED FROM POTTERY.

Clay roofing.—Made of coarse, red brown clay, showing the impression of a roof timber. In one instance in a mealing shed and in several instances in pits such masses of baked clay were found. Their preservation was due, no doubt, to the destruction of a house by fire. (No. 292076, U.S.N.M.)

Textiles.—There was not a trace of basketry or cloth found in the pit village, but the presence of spindle whorls of pottery would indicate that cord or thread making as a preliminary to weaving was practiced.

SUMMARY.

Our present knowledge of the Pit Dwellers of this section places them on the high mountains at the head of the San Francisco River, in a limited area at 7,000 feet elevation. No one may say that they have not a more extensive range along the mountains, as the traces of their villages are very obscure.

The Pit Dwellers evidently carefully selected for the site of their villages smooth, slightly convex, gently-sloping fans, bordering the alluvial lands, which formerly were lake bottoms. These areas show no surface erosion and the subsoil is a free-draining sandy clay. A familiarity with the topography of one of these sites will enable the archeologist to recognize other sites even where stone villages have been built on the area subsequently. It is desirable to ascertain as far as possible the range of this peculiar culture and whether it extends far out of the bounds in which it is placed by our observations heretofore. At present we know only three pit-village sites here and all would lie in a circle 7 miles in diameter.

Should such remains exist in Johnson Basin, which lies northeast of Luna 18 miles by the easiest crossing of the Datil Range, the problem of distribution to the north of this great barrier would be simplified. Johnson Basin looks out into the Quemado-Zuni-Acoma region, a vast basin country on the Continental Divide and north of the Datils. The mountain masses, which flank the Datils, are very picturesque, are well watered, and would serve as stations in a migration east and west from the White Mountains of Arizona to the Rio Grande. They are, from west to east, the vast black bulk of the Escudilla, the white slides of the Fox, the Demetro range of the western Datils, the mesa-like Escondido of the middle Datils, and the beautiful Allegre range of the eastern Datils. Important ruins are reported in the Fox and Demetro Mountains of the above series. It appears probable for topographical reasons that the route through Blue River, Luna, Johnson Basin, Quemado, Zuni, or Acoma was the ancient migration channel between the north and the south.

Subsistence.—In the high mountain valley of Luna (7,200 feet) after the seasonal rains, there is considerable herbaceous vegetation, some of which may have been utilized by the Indians. Along the streams are wild currants and other mountain berries. The season is not too short for the maturing of hardy corn, such as is now raised by the farmers in the valley. At Alpine, Arizona, maize is raised at 8,000 feet. It is probable that the pit-house people cultivated maize on small irrigated tracts on the perennial streams entering the valley sufficient for their small population. The presence of metates and manos would indicate the use of maize. Acorns, piñon nuts, and cedar berries were at times abundant in the mountains, and agave "mescal" could be secured within convenient distance in the Blue and other canyons on the southern slope.

Animal food was provided principally by the deer, whose bones preponderate in the refuse. The loose bones of mammals, procured during the excavation of the pits, have been identified by Mr. G. S. Miller, jr., of the United States National Museum, who lists deer, buffalo, bear, wolf, and several small mammals; and Maj. R. W. Shufeldt, United States Army, has identified the remains of birds and lists turkey, hawk, and ruddy duck.

The presence of buffalo is in line with the finding of the remains of this animal in the Tularosa cave, not far to the east of Luna,[1] and extends the former range of the buffalo westward. The finding of the bones of the White Mountain elk also was anticipated, but not a vestige was discovered, though Luna Valley is in the range of this recently extinct animal.

The presence of the duck is in consonance with the theory that bodies of water may still have remained in the basins—now dry or containing cienagas—at the time when the pit people lived in this region.

A comparison of the artifacts possessed by the Pit Dwellers and by the peoples of normal pueblo type shows in a remarkable way the simplicity of their life. No axes, hoes, or digging stones were found; no large chipped objects; no pipes or cloud blowers; no beads, shells, or turquoise; and no pottery figurines definitely pit dweller—in contrast with the numerous specimens from the stone ruins.

Some points on the age of the Luna Pit Village were derived from a study of the drainage and soil. The top soil is a rich brown to black loam 1 foot thick, which also fills the pits. (See pls. 29 and 30.) The loam is believed to be a forest formation, and it is thought that subsequent to the occupation by man the area was covered with a heavy growth of pines. Excavations under pine stumps show pottery, etc., 3 feet beneath the roots, which observation may be taken for what it is worth. There are 50 dead and about 100 live trees on the area now.

The culture of the Pit Dwellers was, from the evidence secured, quite simple and much less advanced than that of the mountain pueblos of stone construction, whose ruins are abundant in the neighborhood. The culture is inferior to that of any of the sites in the Southwest which the writer has investigated. This fact gives necessarily the aspect of considerable antiquity to the remains, which may or may not be justifiably deduced. Several circumstances suggest a long inhabitation of this region, but present inconclusive evidence. There are quasi indications of the presence of man in the basin along the upper San Francisco River when these basins were lakes.

Another suggestion of age is given by the drainage. On the east side of the pit village at Luna is a perennial stream of small volume which has cut a narrow, deep channel through the lacustrian alluvium. An abandoned course of the stream diverges from the present course at a ledge of hard, white rock (andesite?), which is capped by a ledge of vesicular basalt. On the white ledge the stream has cut 10 feet below the probable bed of the dry channel. Farther down the stream cuts through the detritus to a depth of 12 feet below the bed of the dry channel opposite the great dance pit. (Pl. 37.) The gulch is about 20 feet deep at the road crossing near the store at Luna. The stream enters the San Francisco River after its course across the bottom land. Large pines grow in both gulches, but larger and more numerous along the present stream. A pine 113 inches in circumference grows on the bank of the dry channel. The old channel is about 80 feet wide and is now being slowly silted up by aerial agencies. (Pl. 38.) It had probably cut in 12 to 15 feet. On its bank was dug the great dance pit. (See plan.) The drainage area of the stream is small and the erosion slight, so that the changes here must have taken considerable time.

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[1] Hough, Bulletin 87, U. S. National Museum, 1914, p. 5.

The manner of the disposal of the dead among the Pit Dwellers has not been solved. Some years ago the construction of the main irrigating ditch and the consequent removal of great amounts of earth disturbed a burial accompanied with pottery, which is described by informants as being coarse and black. These relics were not preserved. Excavations in the summer of 1916 and 1917 brought out only the remains of infants, which were buried after the Pueblo fashion with mortuary deposits of pottery. Based on the evident length of inhabitation of the pit village, hundreds of burials would have been expected. No explanation of the absence of burials can be offered at present, unless cremation or some custom such as tree or scaffold burial or other open-air exposure was practiced.

There is as yet limited data for correlating with the Luna pit ruins, the rooms discovered by Dr. J. Walter Fewkes during his important explorations of the ruins of Casa Grande, which were encountered beneath the walls of compound B of Casa Grande group, and appear to antedate these constructions.[1] There is some reason to see a similarity between the Pima circular mud-plastered house with accompanying ramada or shed[2] and the Luna pits with adjoining shed. This type is unquestionably southern.

Concerning the subterranean houses described by Melchior Diaz on his journey northwest from the town of Sonora in search of the sea coast, he says: "They came to a province of exceedingly tall and strong men-like giants. They are naked and live in large straw cabins, built underground like smoke houses, with only the straw roof above ground. They enter these at one end and come out at the other. More than a hundred persons, old and young, sleep in one cabin."[3]

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[1] 28th An. Rep. Bur. Amer. Eth., p. 102, pl. 41.

[2] See Pima Papago village group, Natural History Building, U. S. National Museum.

[3] 14th An. Rep. Bur. Amer. Eth., p. 485.

Were these communal houses of the ancestors of the Yumas?

The curious relationship in a number of respects between the culture of the zone of great pueblos in the north and that of the southern side of the great escarpment (rim) which runs from the Grand Canyon to the Continental Divide is interesting. In pottery we have the incised decoration in coil (fig. 32); partial decorative use of coil on necks and rims of vessels; the serpent figure; long-necked handled vases, and, in wood, the throwing stick, roundel pahos, etc. It is possible that the greatest development of pit structures will be found in the north. There have been discovered the circular "slab houses" of Monument Valley, northeastern Arizona; the circular houses of the "Basket Makers" of Grand Gulch, Utah;[1] and other ruins of northern New Mexico which suggest that this type of habitation is more than sporadic. It is expected also that the artifacts will show characteristics which can be used to demark this culture. In the Little Colorado Valley two ruins have been described as enigmatic at the time of their discovery, but may now be affiliated with the pit-house culture. These ruins are in the neighborhood of the Petrified Forest of Arizona.[2] One of these, on the slopes of the Mesa Prieta at Woodruff, consists of a large number of shallow basins, and the other on Canyon Butte wash shows circles of slabs and metates set up on the slopes of a small hill. From records in the field notes the pottery and other artifacts conform to those of the pit-house culture. A more detailed examination of these ruins is implied.

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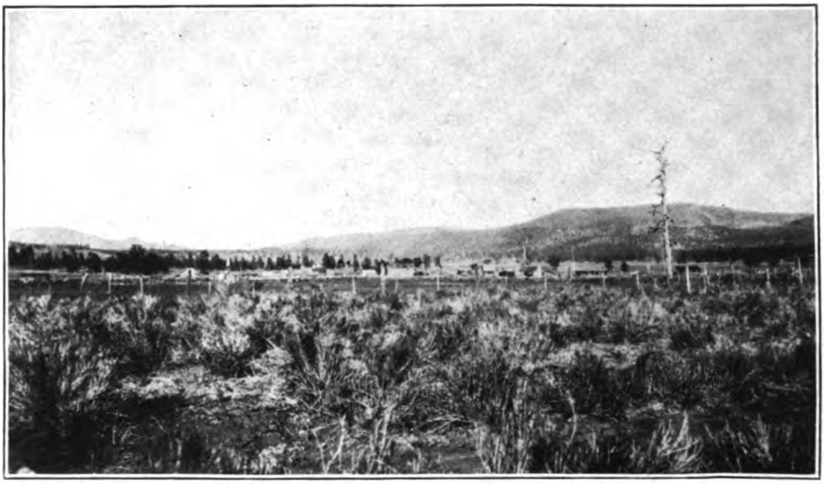
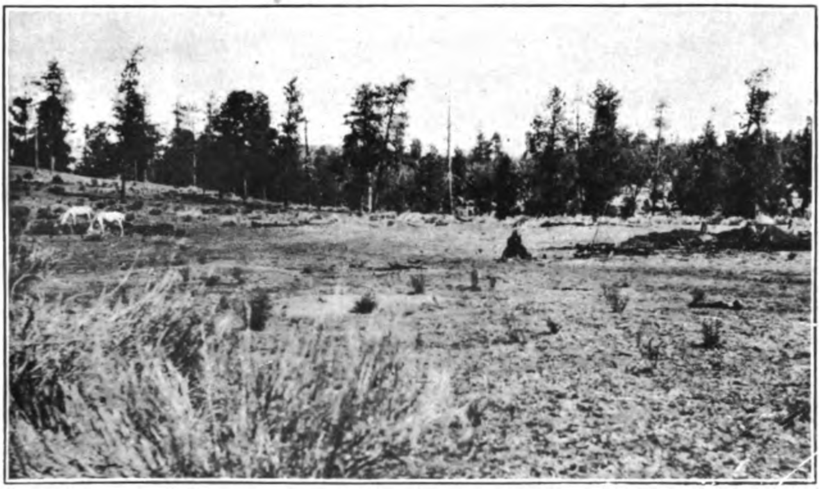
[1] Kidder. Prehistoric Cultures of the San Juan Drainage, Proc. 19th Intern. Cong Americanist, Washington, 1917, p. 108–109.

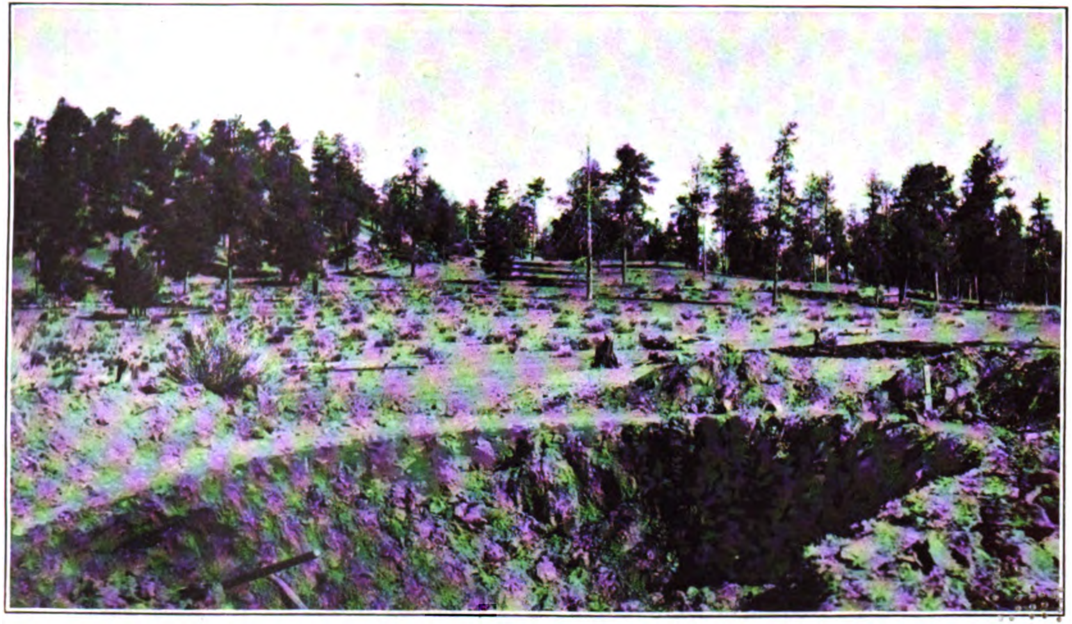
[2] Hough. An. Rep. U. S. Nat. Mus., 1901, p. 318.



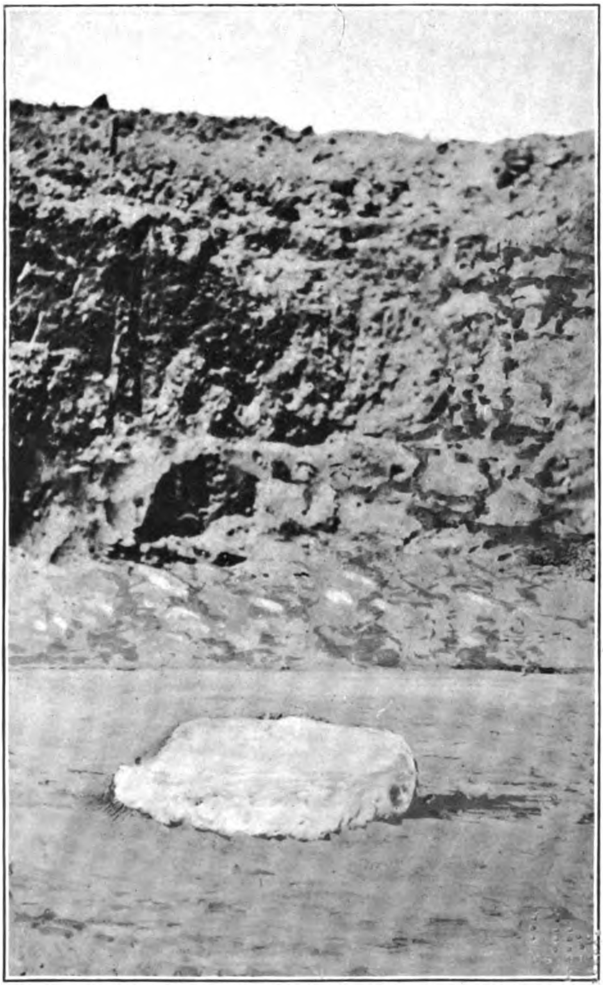
VIEW ACROSS PIT VILLAGE TOWARD LUNA.



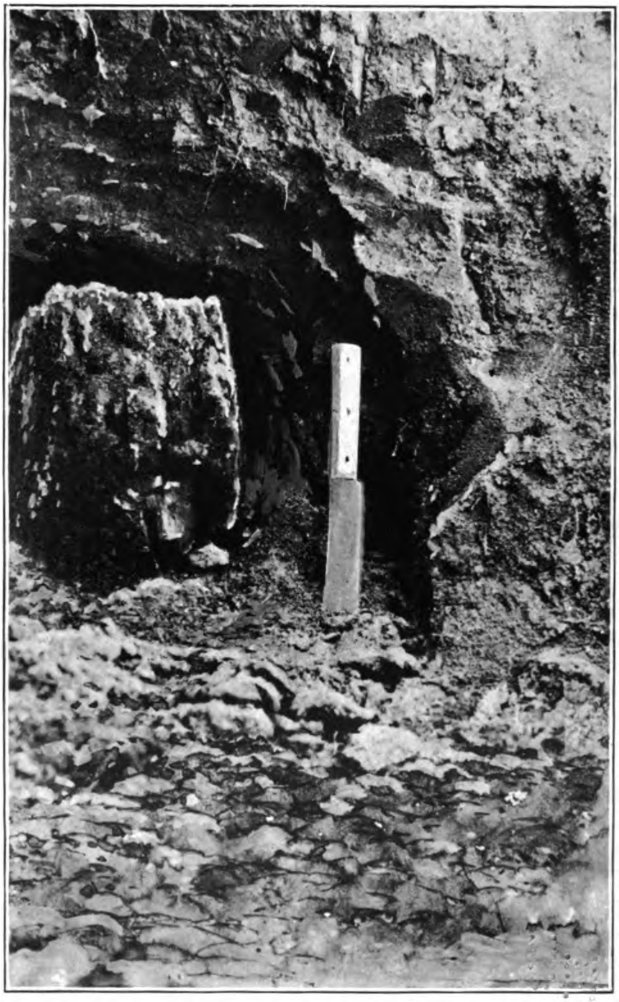
VIEW ACROSS UPPER PORTION OF PIT VILLAGE.



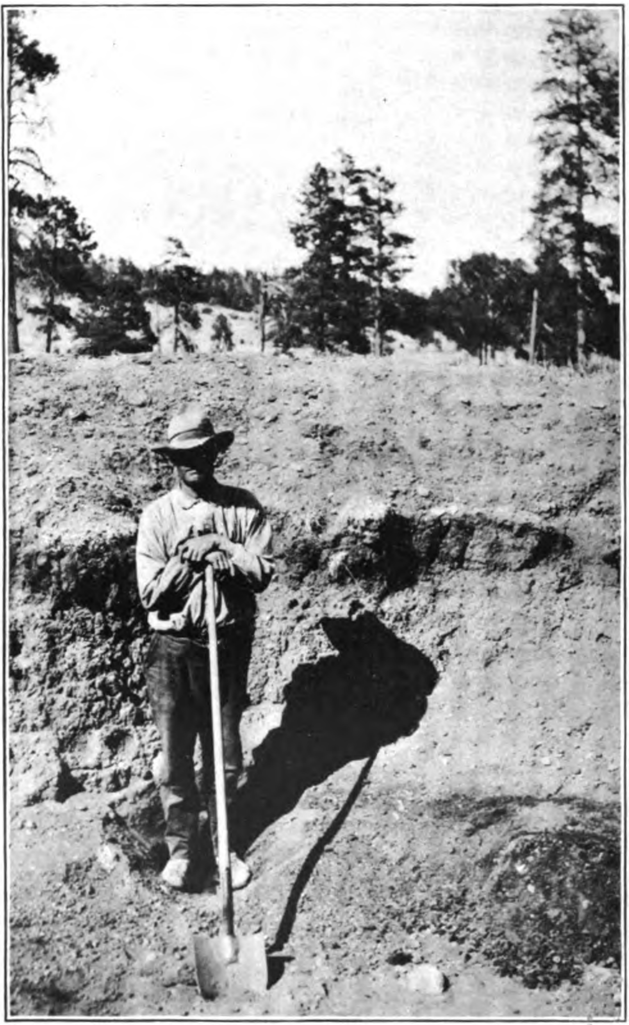
PIT HOUSE OPENED.



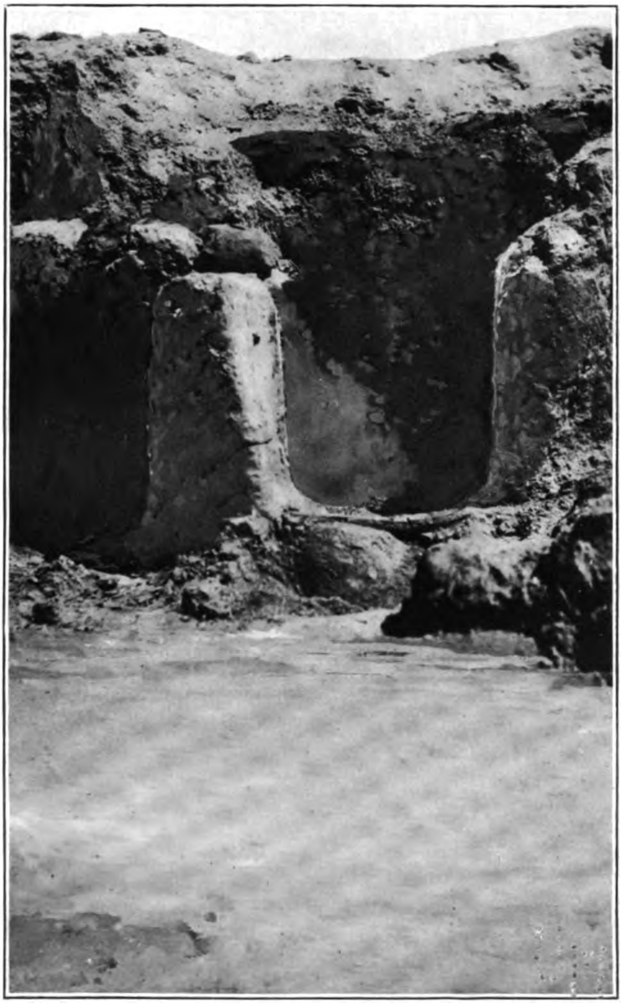
METATE ON FLOOR OF PIT HOUSE.



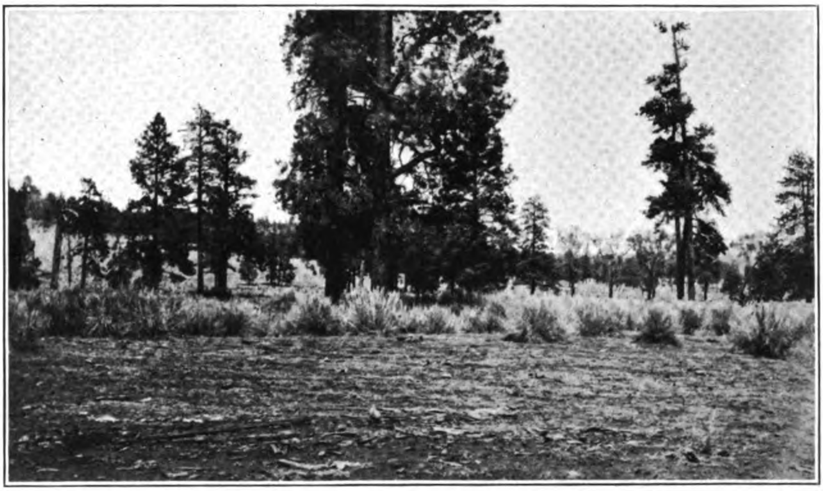
CHARRED STUMP OF HOUSE POST.



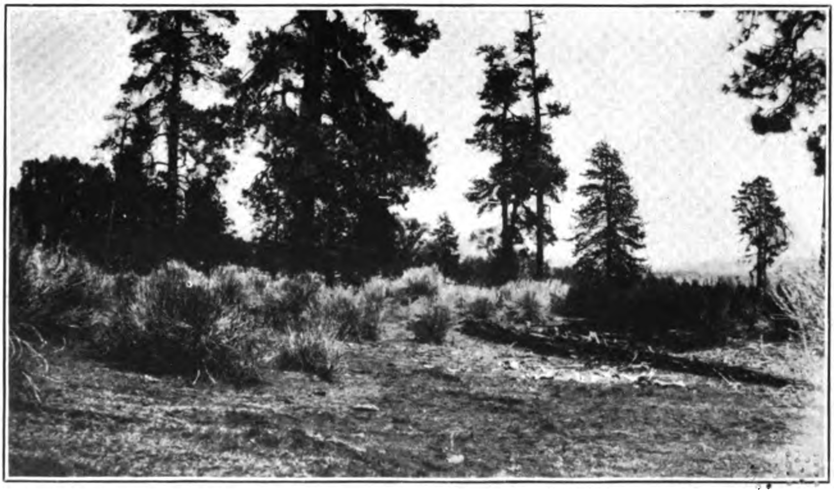
SIDE WALL OF PIT HOUSE NO. 4.



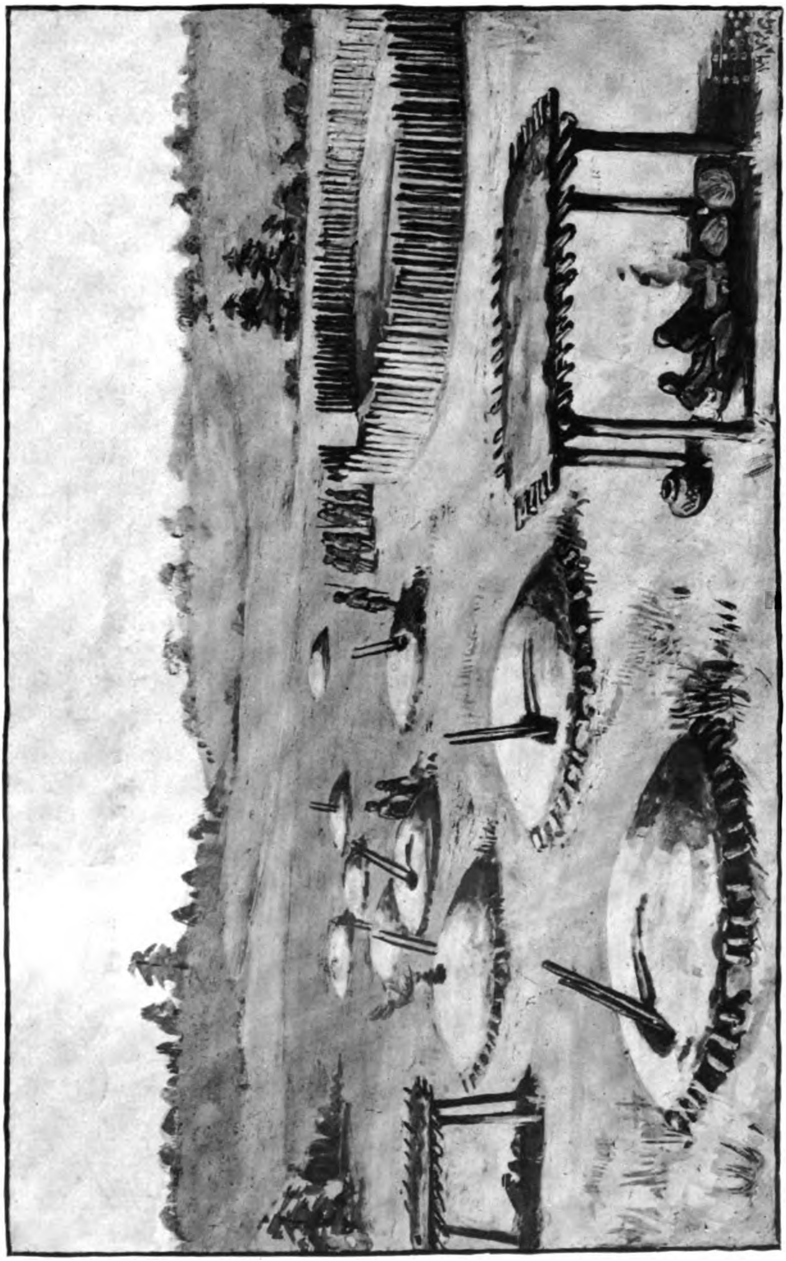
FIREPLACE WITH BAKED CLAY JAMBS.



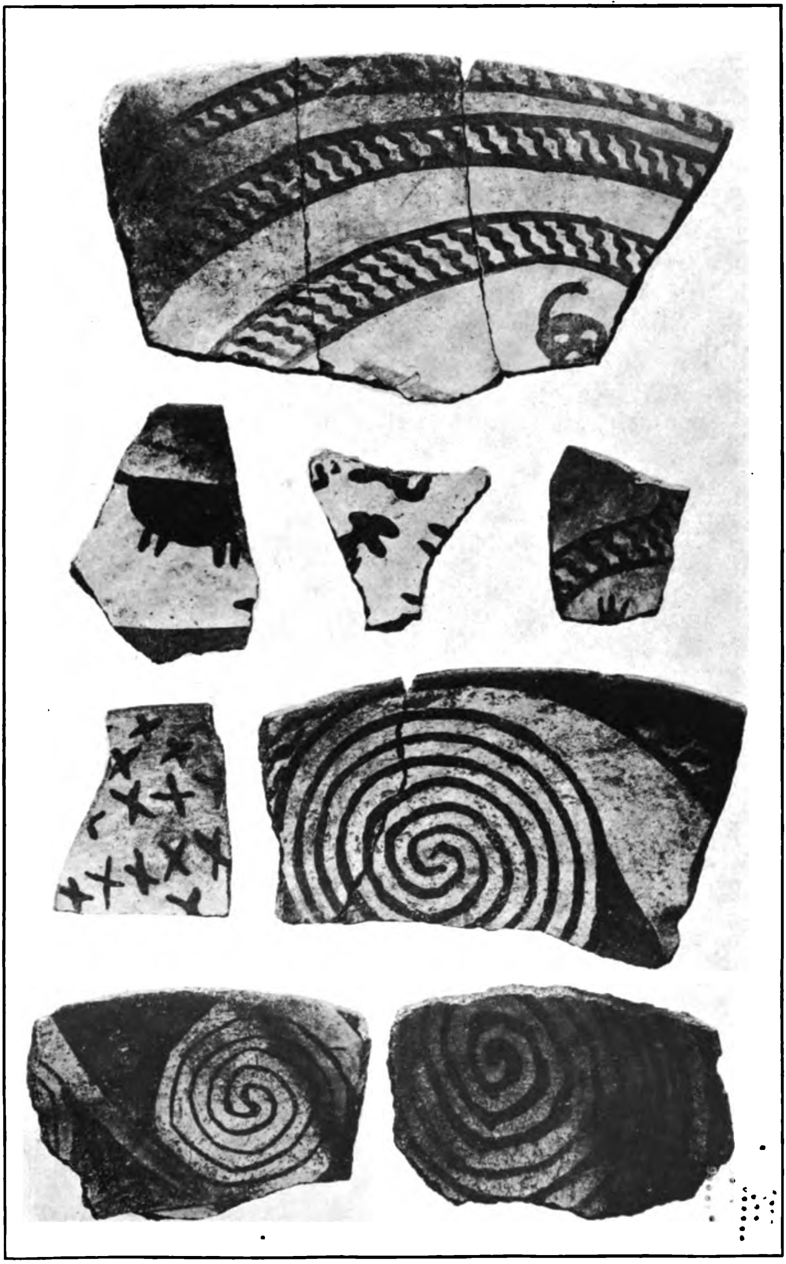
View Across Great Dance Pit.



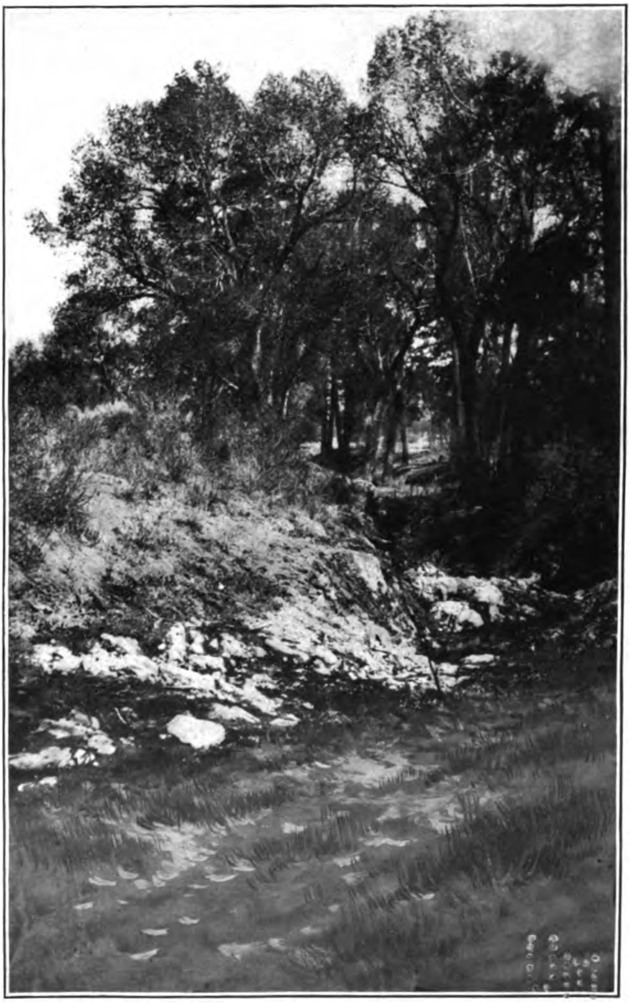
View of Edge of Dance Pit.



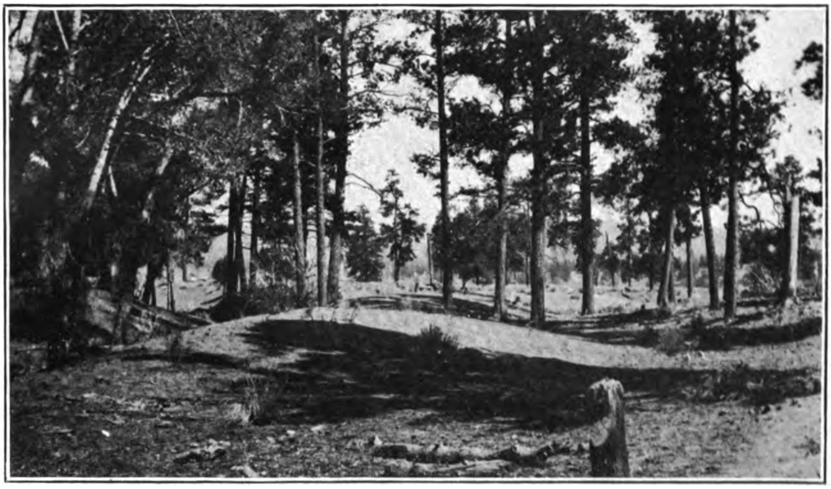
RESTORATION OF ANCIENT PIT VILLAGE.



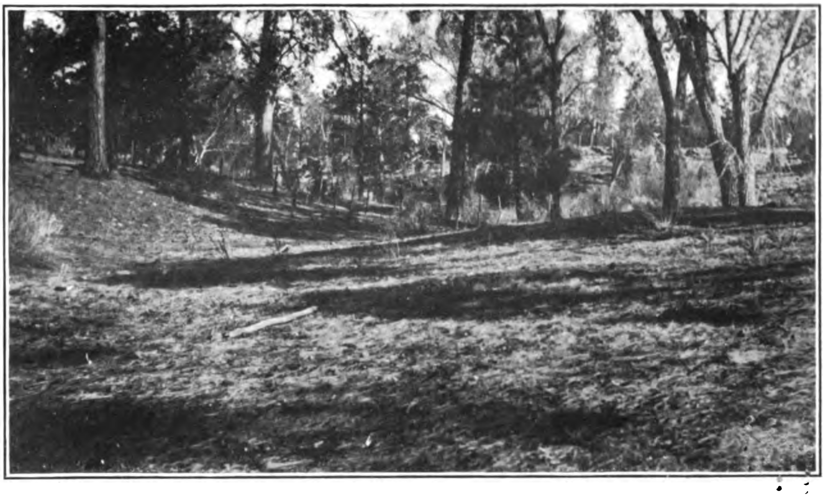
POTTERY FRAGMENTS SHOWING SPECIAL DECORATION.



CHANNEL OF LIVING STREAM NEAR DANCE PIT.



Looking Down Present Channel of Permanent Water.



Ancient Channel of Stream.

A REVISION OF THE CHALCID-FLIES OF THE GENUS HARMOLITA[1] OF AMERICA NORTH OF MEXICO.

By W. J. Phillips and W. T. Emery,

Of the Bureau of Entomology, United States Department of Agriculture.

INTRODUCTION.

As the genus *Harmolita* (*Isosoma* of authors) includes some species of very great economic importance the writers have made this detailed study of it in order that it may be possible to identify material with certainty in the future.

The genus, as it is known to the writers now, embraces 29 species, 17 of which are new to science. The biology of the different members of the genus has been studied as far as possible in connection with the structural characters, with the result that a number of new species has been added, while some of the old ones must pass into synonomy. Some species whose biology is only partly known or wholly unknown may have to be split up further when more is learned about their life histories, since the writers have erected new species only where it seemed absolutely necessary.

The writers wish to acknowledge their indebtedness to Mr. W. R. Walton, chief of the Division of Cereal and Forage Insects of the Bureau of Entomology, for helpful suggestions and for kindly allowing the artist of the division, Miss Esther Hart, to prepare the necessary drawings; to Mr. A. B. Gahan for many kindly criticisms of the manuscript; to many other members of the division for collecting and sending infested grasses, more particularly to Mr. George I. Reeves, E. O. G. Kelly, C. N. Ainslie, C. W. Creel, and V. L. Wildermuth; to Dr. Henry Fox, Messrs. Philip Luginbill, and T. H. Parks for help rendered while serving at different times as assistants to the senior writer; to Mr. Derle Bennion, Salt Lake, Utah, to Prof. R. W. Doane, Stanford University, California, and to the Hon. W. S. Ratliff, Richmond, Indiana, for sending material; to Mr. J. C. Crawford for helpful suggestions and for placing the types and collections of the United States National Museum at the disposal of the writers.

METHODS OF STUDY.

As has been previously stated, upon taking up the study of this group, it was decided to approach the problem from the biological side first. It therefore seemed necessary to rear each species separately, under confinement. To accomplish this the different species of grass and grain stems that were found to be infested were carefully isolated. Upon closer examination, however, it was learned that there were often two distinct types of injury upon the same species of plant. Larvae were found occupying distinct warty or gall-like distortions along the stems and others were found in the center of the stems, just at the nodes. These were then separated according to the manner of injury to the plant and each kind isolated. Upon the emergence of adults, individuals from each source were confined upon healthy growing plants of the same species from which they had been taken. The writers found that each lot of individuals continued to breed in the same manner, either always inhabiting the center of the stem or forming galls, as the case might be. The experiments then proceeded a step further; each gall-inhabitor from a given plant was tried on a series of different hosts. This same method was also used for those that inhabited the center of the stems. The results of these tests over a number of years proved that, with a few exceptions, each species steadily refused to accommodate itself to a strange host.

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[1] Order Hymenoptera. Family Eurytomidae.

Unfortunately the writers have been unable to rear in confinement all species dealt with in this paper, and they have never even had the pleasure of observing living specimens of *poophila*, *agropyrocola*, *agrostidis*, *bromicola*, *elymophila*, *elymoxena*, and *gillettei*.

There are five species that seem to be distinctly western and have steadily refused to breed here in the Eastern States. These are *ovata*, *rufipes*, *hesperus*, *occidentalis*, and *elymophthora*. On the other hand, there are 10 species that have never been taken west of the western boundary of Missouri, namely, *tritici*, *secalis*, *hordei*, *poae*, *captiva*, *dactylicola*, *festucae*, *atlantica*, *elymicola*, and *maculata*. The remaining seven species, *vaginicola*, both forms of *grandis*, *websteri*, *albomaculata*, and *elymi*, are found very nearly all over the United States where their hosts normally occur; *elymivora* and *agropyrophila* have been found as far west as Kansas.

After breeding had apparently definitely established the distinctness of a species, it was studied carefully for structural characters upon which to differentiate it. The saws or ovipositors seemed to offer the most secure basis, in that there was less variation in this character and the differences were often quite striking.

After mounting the ovipositors of all species at hand it was found that a few species were so close that there was difficulty in separating them on this character alone. A careful study of external characters at this stage showed that every species could be readily identified on groups of characters based on external structure. Therefore the analytical tables given herewith are based exclusively on the external structure. The saws or ovipositors of every species, except one (*agrostidis*), are illustrated, however, so that, whenever necessary, they may be used as a last resort, for identifying a species. There are so few specimens of *agrostidis* that it seemed inadvisable to mutilate any of them. No descriptions have been drawn up for the ovipositors, since it seemed utterly useless. There is little difference in the ovipositors of the different species as seen in profile; the main difference is in the dorsal view and consists in size, shape, and arrangement of denticles.

There are two more or less distinct types of ovipositors, as will readily be seen by referring to plates I, II, and III. These two types of ovipositors bear a distinct relation to the type of injury inflicted upon the plant by the insect and are also coordinated with the external structure or sculpturing of the thorax. In other words, one is able to determine definitely, with one exception, whether a species inhabits the center of the stem or whether it is a gall-former, by a glance at the ovipositor or the sculpturing of the thorax of the species in question. All gall-formers, with the exception of *captiva*, have the rugulose praescutum (pl. 42, fig. 1) and ovipositors of the general type illustrated in plate 41, with denticles on the rods, while those that inhabit the center of the stem have the reticulate praescutum (pl. 42, fig. 2) and the ovipositors of the general type represented by plate 39, figure 2, without denticles on the rods. The exception. *captiva*, is apparently more closely related to the species that inhabit the center of the stem.

Tables for the identification of both males and females are included, though the males can not always be identified with certainty. Besides, there are a number of species in which males rarely occur, so that, on the whole, identifying a species from males alone is unsatisfactory.

The ovipositors may be mounted most easily from freshly killed specimens, though they may readily be mounted from dried specimens also by dropping the abdomen in a hot, concentrated solution of potassium or sodium hydrate for a few minutes. The ovipositors may then be dissected out as in fresh specimens, dehydrated in alcohol, cleared in carbol-zylol and mounted in Canada balsam.

Genus HARMOLITA Motschulsky.

Isosoma WALKER, Ent. Mag., vol. 1, 1832, p. 13. (Not *Isosoma* Billberg, 1820, Coleoptera). (Type, *Ichneumon verticillata* Fabricius.)
Harmolita MOTSCHULSKY, Bull. soc. nat. Moscow, vol. 35, 1863, p. 58. (Type, *H. longicornis* Motschulsky.)
Philachyra (Haliday) WALKER, Notes on Chalcid., pt. 1, 1871, p. 7.

The writers have restricted the genus *Harmolita* to those species without a carinate occiput and having the praescutum either smoothly reticulate and shining (as in *grandis*), reticulately lineolate (as in *maculata* (pl. 42, fig. 2)), reticulately lineolate with shallow, irregularly placed, indefinite punctures (as in *captiva*) or ruglose (as in *tritici* (pl. 42, fig. 1)). This excludes all species having the carinate occiput or an even, distinct, umbilicate punctation on the praescutum and other portions of the thorax, even though the punctation be faint. The genus thus restricted excludes Howard's species, *hageni*, *bromi*, and *californicum*, and Ashmead's *abnorme*, *montanum*, and *nevadense*, all of which belong to the Eurytomines. The senior writer has examined the types of these excluded species. Nothing is known of their life history.

GLOSSARY.

Annulations=The rings or elevations on the distal extremity of the flagellar joints of the antennae of some males (pl. 47, figs. 1, 7, 8).

Groove=The longitudinal, margined depression or groove down the center of the propodeum (pl. 43, fig. 3).

Spiracular carinae=The carinae that curve around from the groove or from near the center of the propodeum to the spiracles (pl. 43, fig. 2).

TABLE 1.—FEMALES.

1. Praescutum smoothly reticulate, brownish ---------- 2.
   Praescutum reticulately lineolate, black ---------- 3.
   Praescutum rugulose ---------- 13.
2. Wingless and small; mesothorax slightly longer than prothorax. *grandis* form *minuta* Riley.
   Winged and large; mesothorax twice as long as prothorax. *grandis* form *grandis* Riley.
3. Propodeum without distinct, continuous, margined groove; occasionally *albomaculata* has a margined groove ---------- 4
   Propodeum with a distinct margined groove ---------- 6
4. Abdomen distinctly shorter than thorax ---------- *agrostidis* Howard.
   Abdomen longer than thorax ---------- 5
5. Propodeum rugose, generally with a central longitudinal carina; abdominal segments 5 and 6 each distinctly longer than either 3 or 4; species large ---------- *websteri* Howard.
   Propodeum usually granulose; abdominal segments 5 and 6 each same length as 3 and 4; species small ---------- *albomaculata* Ashmead.
6. Pronotal spots small to minute ---------- 7.
   Pronotal spots medium to large, occupying about one-half anterior dorsal margin of prothorax ---------- 8.
7. Pronotal spots plainly visible from above; first funicle joint plus ring joint only slightly longer than pedicel; abdomen longer than thorax; greatest vertical diameter of the abdomen at third segment ---------- *captiva* Howard.
   Pronotal spots scarcely visible; first funicle joint plus ring joint distinctly longer than pedicel; greatest vertical diameter of the abdomen often at fifth segment; abdomen shorter than thorax ---------- *poae*, new species.
8. Groove broad, usually wider posteriorly ---------- 9.
   Groove narrow, marginal carinae of groove parallel ---------- 10.
9. Rugose within and laterad of the groove; first funicle joint almost twice as long as pedicel; praescutum with numerous broad, shallow impressions ---------- *dactylicola*, new species.
   Rugose within and usually granulose laterad of the groove; first funicle joint only slightly longer than pedicel; praescutum without (rarely with) broad, shallow impressions ---------- *albomaculata* Ashmead.

10. Area laterad of groove granulose-- 11.

Area laterad of groove rugose-- 12.

11. Pronotal spots large; species not slender------------------- *elymi* French.

Pronotal spots very large, almost meeting above; species very slender. *bromicola* Howard.

12. Abdominal segment 7 usually shorter than 6; 3 always as long as either of these; first funicle joint longer than pedicel----------- *maculata* Howard.

Abdominal segment 7 usually longer than 6; 3 always shorter than 7; first funicle joint same length as pedicel----------- *agropyrophila*, new species.

13. Propodeum without distinct continuous median grooove--------------- 14.

Prododeum with distinct continuous median groove------------------ 15.

14. Legs black, brownish at knees, pronotal spots prominent------ *tritici* Fitch.

Legs reddish-brown, occasionally dusky, pronotal spots inconspicuous. *hordei* Harris.

15. Pronotal spots small, occupying about one-half or less of the anterior dorsal margin of prothorax-- 16.

Pronotal spots large, occupying two-thirds or more of the anterior dorsal margin of prothorax-- 19.

16. Legs reddish-brown---------------------------------- *rufipes*, new species.

Legs black except at knees, and sometimes the front tibiae------------- 17.

17. Abdomen long and narrowly lanceolate-------------- *festucae*, new species.

Abdomen not especially long and narrowly lanceolate----------------- 18.

18. Propodeal fimbria strong; propodeum rugose; abdominal segment 4 longer than 6-- *vaginicola* Doane.

Propodeal fimbria weak; propodeum often granulose within and laterad of groove; abdominal segments 4 and 6 subequal; tibiae dusky brown -- *secalis* Fitch.

19. All tibiae reddish-brown-- 20.

All tibiae not reddish-brown-- 21.

20. Fifth joint of funicle distinctly longer than broad; first funicle joint distinctly longer than pedicel; abdomen lanceolate---- *hesperus*, new species.

Fifth joint of funicle not distinctly longer than broad; first funicle joint not distinctly longer than pedicel; abdomen lanceolate. *agropyrocola*, new species.

Fifth joint of funicle slightly broader than long; fourth quadrate; first funicle joint not distinctly longer than pedicel; abdomen ovate. *ovata*, new species.

21. Groove shallow, many times broader than deep anteriorly------------- 22.

Groove deep, from 2 to 3 times as deep anteriorly---------------- 23.

22. Fifth joint of funicle as broad as long; abdomen rather stout; groove shallow and distinctly broader anteriorly--------- *elymoxena*, new species.

Fifth joint of funicle distinctly longer than broad; groove broadest anteriorly and abdomen rather stout------------------ *elymicola*, new species.

Fifth joint of funicle usually longer than broad; fourth as broad as long; groove usually broadest near center; abdomen slender. *atlantica*, new species.

23. Abdomen, lateral view, equal in length to head and thorax combined-- 24.

Abdomen, lateral view, longer than head and thorax combined-------- 25.

24. Pronotal spots very large, occupying about three-fourths anterior dorsal margin of prothorax; prothorax brownish laterally; fourth and fifth joints of funicle and first 2 club joints quadrate--*elymophila*, new species.

Pronotal spots medium to large, occupying less than two-thirds anterior dorsal margin of prothorax; prothorax not brownish laterally; funicle and club joints distinctly longer than broad-------- *poophila*, new species.

Pronotal spots large, occupying two-thirds anterior dorsal margin of prothorax; prothorax not brownish; fifth funicle and first two club joints quadrate---------- *elymoxena*, new species.

25. Vertical diameter of abdomen at sixth segment only slightly less than its greatest vertical diameter---------- *elymivora*, new species.

Vertical diameter of abdomen at sixth segment about one-half its greatest vertical diameter---------- 26.

26. Front femora and tibiae reddish-brown---------- *elymophthora*, new species.

Front femora and tibiae not reddish-brown---------- 27.

27. Middle and hind tibiae fuscous; propodeum convex laterad of groove; abdomen slender---------- *occidentalis*, new species.

Middle tibiae fuscous; hind tibiae brownish; not especially convex laterad of groove; abdomen rather stout---------- *gillettei*, new species.

Middle and hind tibiae black; propodeum not convex laterad of groove; usually granulose within and laterad of groove---------- *elymicola*, new species.

TABLE 2—MALES

1. Praescutum reticulately lineolate---------- 2.

Praescutum rugulose---------- 9.

2. Pronotal spots minute, not visible from above---------- 3.

Pronotal spots small but visible from above---------- 4.

Pronotal spots large, occupying one-third to one-half anterior dorsal margin of prothorax---------- 6.

3. Propodeum without groove; thorax very smooth, almost polished; scape in lateral profile distinctly longer than broad and broadest near the base. *grandis* form *minuta* Riley.

Propodeum with complete groove ,thorax not particularly smooth and not polished; scape in lateral profile almost as broad as long---------- *poae*, new species.

4. Praescutum with numerous broad and very shallow impressions; pronotal spots scarcely visible from above; scape in lateral profile broadest at center; third flagellar joint about twice as long as broad---------- *captiva* Howard.

Praescutum without impressions, pronotal spots clearly visible from above; scape in lateral profile broadest near base; third flagellar joint about 4 times as long as broad---------- 5.

5. Three to four annulations at the distal extremity of the penultimate segment of flagellum; petiole and hind coxae of equal length. *agropyrophila*, new species.

One annulation at the distal extremity of the penultimate segment of the flagellum; petiole shorter than hind coxae---------- *maculata* Howard.

6. Flagellum and pedicel together longer than head, thorax, and petiole combined---------- *albomaculata* Ashmead.

Flagellum and pedicel together shorter than head, thorax, and petiole combined---------- 7.

7. Propodeal groove incomplete; spur on end of apical joint of antennae conspicuous, about 4 times as long as broad---------- *websteri* Howard.

Propodeal groove complete---------- 8.

8. Spur on end of apical joint of antennae inconspicuous, about twice as long as broad; tibiae black; species robust---------- *dactylicola*, new species.

Spur on end of apical joint of antennae long and slender, about 4 times as long as broad; tibiae brownish-black; species very slender. *bromicola* Howard.

9. Without propodeal groove---------- 10.

With propodeal groove---------- 13.

10. Petiole three-fourths to about equal the length of hind coxae---------- 11.
Petiole one-half the length of hind coxae---------- 12.
11. Propodeum rugose; pronotal spots not visible from above------ *tritici* Fitch.
Propodeum granulose; pronotal spots visible from above. *atlantica*, new species.
12. Pronotal spots not visible from above; all tibiae reddish-brown. *hordei* Harris.
Pronotal spots visible from above; tibiae dusky---------- *secalis* Fitch.
13. Tibiae reddish-brown---------- 14.
Middle and hind tibiae brownish to black---------- 15.
14. All femora reddish-brown---------- *rufipes*, new species
Basal one-half to two-thirds of hind and basal one-third of middle femora blackish---------- *hesperus*, new species.
15. Pronotal spots minute, scarcely visible from above---------- 16.
Pronotal spots occupying less than one-half anterior dorsal margin of prothorax---------- 17.
Pronotal spots occupying two-thirds anterior dorsal margin of prothorax-21.
16. Scape, as seen laterally in profile, approximately same width throughout and about 8 times as long as broad, no shoulder distally. *festucae*, new species.
Scape, as seen laterally in profile, approximately same width throughout, and about 4 times as long as broad and with a slight shoulder distally---------- *tritici* Fitch.
17. Scape, as seen laterally in profile, approximately same width throughout; shoulder low---------- 18.
Scape, as seen laterally in profile, much broader near distal extremity; shoulder high and very prominent---------- 19.
18. Flagellum longer than head and thorax combined------ *ovata*, new species.
Flagellum equal to or shorter than head and thorax combined. *poophila*, new species.
19. Pronotal spots usually bright; flagellum equal to or longer than head and thorax combined---------- 20.
Pronotal spots dull and obscure; flagellum shorter than head and thorax combined---------- *elymoxena*, new species.
20. Groove deep; propodeum rugose; pronotal spots usually occupying one-half anterior dorsal margin of prothorax; bristles on first flagellar joint only slightly longer than its diameter; bristles very numerous. *elymivora*, new species.
Groove shallow; propodeum granulose; pronodal spots usually occupying one-third anterior dorsal margin of prothorax; bristles on first flagellar joint about twice the length of its diameter; bristles somewhat sparse. *occidentalis*, new species.
21. Pronotal spots bright---------- *elymicola*, new species.
Pronotal spots usually dull---------- *elymophthora*, new species.
Pronotal spots dull, often giving anterior margin of prothorax a brownish tint---------- *elymophila*, new species.

ILLUSTRATIONS.

It seemed unnecessary to the writers to have drawings made of the entire insect as in the majority of cases no specific difference can be illustrated in this manner. Drawings were made of the propodea, ovipositors or saws, and the antennae. In other words only those parts were drawn which most clearly showed specific characters. While the shape of the abdomen is specific in many instances it shrinks greatly in different directions upon the death of the insect, and it was therefore thought unnecessary to illustrate it.

DESCRIPTIONS OF SPECIES.

HARMOLITA GRANDIS form GRANDIS Riley.

Plate 39, fig. 4; plate 45, fig. 20.

Isosoma grande Riley, Bull. Brooklyn Ent. Soc., vol. 7, p. 111, 1884.
Isosoma (*Philachyra*) *grande* (Riley) Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 9, 1896.

This was originally described by Riley as follows:

Female.—Length of body, 4.2 mm.; expanse, 7.6 mm.; antennae rather more slender and less clavate than in the spring form and but half the length of the thorax. Thorax with the mesonotum slightly more rugulose; wings larger and less hyaline than in the winged specimens of the spring form, with the veins extending to the outer third, the submarginal nearly 4 times as long as the marginal; legs with the femora less swollen. Abdomen not so long as the thorax, stouter than in the spring form, ovate-acuminate, approaching typical Eurytoma. Less hairy than in the spring form, especially about the legs, the hairs about the abdomen being less numerous, less regular, and shorter. Coloration similar to that of spring form, but brighter and more highly contrasting, the pronotal spots larger and brighter yellow, the pedicel of the antennae yellow, and the femora with a definitely limited suboval yellowish spot below, near the tip, extending two-fifths the length of the femur on front pair, smaller on the middle pair, and still shorter and less definite on posterior pair.

Supplementary to Riley's description:

Abdomen from base of second segment shorter than head and thorax combined. First joint of club longer than broad. Pedicel plus ring-joint shorter than first funicle joint. Mesothorax twice as long as prothorax, and broader at scutum. Area laterad of propodial groove black.

Males.—Unknown.

The supplementary descripton of *H. grandis* is based on numerous specimens reared in cages under artificial conditions and from specimens reared from wheat straw collected in several States, from California to the Atlantic and from Canada to Mexico.

This species inhabits the center of the stem and has been reared only from wheat; it is usually found wherever wheat is grown.

Winged females of *H. grandis* form *minuta,* and occasionally wingless females of *grandis* will be found. Both forms are normally thelyotokous, though males of form *minuta* are occasionally met with.

HARMOLITA GRANDIS form MINUTA Riley.

Plate 39, fig. 5; plate 45, fig. 15; plate 48, fig. 1.

Isosoma tritici Riley, Amer. Nat., March, p. 247, 1882 (not *tritici* Fitch).

Riley's original description was as follows:

Female.—Length of body, 2.8 mm.; expanse of wings, 4 mm.; greatest width of front wing, 0.7 mm.; antennae, subclavate, ¾ length of thorax; whole body (with exception of metanotum, which is finely punctulate) highly polished and sparsely covered with long hairs toward the end of the abdomen; adbomen longer than thorax and stouter. Color, pitchy black; scape of antennae, occasionally a small patch of cheek, mesoscutum, femoro-tibial articulations, coxae above and tarsi (except last joint) tawny; pronotal spots large, oval, and pale yellowish in color; wing veins dusky yellow and extending to beyond middle of wing; submarginal three times as long as marginal; postmarginal very slightly shorter than marginal, and stigmal also shorter than marginal.

Supplementary to Riley's description:

Abdomen from base of second segment longer than head and thorax combined. First joint of club broader than long. Pedicel plus ring-joint equal in length to first funicle joint. Mesothorax slightly longer than prothorax and narrower at scutum. Area laterad of propodeal groove brownish.

Male (pl. 48, fig. 1).—Praescutum shining black, polished, with very slight reticulations. Pronotal spots small, scarcely visible from above, and are obscure.

Propodeum convex, without a groove, and coarsely granulose.

Petiole about one and one-half times as long as broad, about two-thirds length of hind coxae. Second abdominal segment bears four hairs or bristles, 2 on each side, other segments also bear conspicuous bristles or hairs.

Legs black except at knees, which are testaceous.

Antennae: Flagellum with pedicel, equal to head and thorax combined. Hairs on first joint of flagellum equal in length to the last joint of the antennae. Tubercle on last joint of antennae only about twice as long as broad. Scape, exclusive of base, one-third as broad as long in lateral profile; is broadest in basal half; no distinct shoulder in distal extremity. Only one annulation at flagellum articulations except at distal extremity of second joints where there are two.

Male.—Heretofore undescribed.

HARMOLITA AGROSTIDIS Howard.

Plate 43, fig. 1; plate 45, fig. 7.

Isosoma agrostidis Howard, U. S. Dept. Agr., Div. Ent., Bull tech. ser. No. 2, p. 12, 1896.

The original description by Howard was as follows:

Female.—Length, 2.8 mm.; expanse, 5.2 mm. Head and mesothorax finely shagreened and also very sparsely and finely rugulose; metanotum somewhat coarsely rugulose and without median furrow, but with a rather faint median, longitudinal carina; mesoscutellum rather rounded at apex, not sharply pointed; axillae and parapsidal sutures nearly meeting, pronotal spots evident but small; scarcely seen from above; first funicle joint of antennae not quite as long as second; remaining joints subequal, somewhat rounded; club joints very distinct, terminal one acuminate and styliferous. Abdomen short and stout, considerably shorter than thorax; subglobose in shape, its second segment occupying nearly half of the whole surface; segments 3 to 7 short, subequal. Entire body very free from pilosity except metanotal fimbria, which is pronounced and white, and except hind coxae which have slight whitish pilosity on the outer side. The claw of stigma club straight, issuing from the tip of club and extending considerably beyond it, club itself abruptly truncate, triangular. Entire body including legs, black except pronotal spots, femoro-tibial knees and tarsi, which are a dark honey yellow.

Supplementary to Howard's description:

Female.—Rather roughly reticulately lineolate on praescutum. Pronotal spots small but clearly visible from above. Propodeum without a distinct, continuous, margined, median, longitudinal groove; there is a faint central longitudinal carina, and often there is a more or less nearly parallel carina on either side; there is a granulose area laterad of center in the posterior portion. Abdominal segments 3 to 9 gradually decreasing in length. 7 equal to 6.

Femora black, knees testaceous, tibiae brownish-black. Fifth flagellar joint as broad as long.

The supplementary description for *H. agrostidis* is based upon the type in the United States National Museum, Washington.

Males.—Unknown.

HARMOLITA WEBSTERI Howard.

Plate 39, fig. 2; plate 43, fig. 2; plate 46, fig. 9; plate 48, fig. 6.

Eurytoma hordei Fitch (not Harris) Seventh Rept. Ins. N. Y. (Author's Edition), p. 154, 1862.

Isosoma websteri Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 15, 1896.

Isosoma hirtifrons Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 16, 1896.

Isoma fitchi Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 20, 1896.

Female.—Praescutum reticulately lineolate and without any broad shallow impressions. Pronotal spots medium, occupying scarcely one-half anterior dorsal margin of prothorax.

Propodeum without a distinct continuous margined groove, although there is a beginning of a groove anteriorly, the prominent margined carinae curving around to the spiracles. There is usually a distinct, continuous central longitudinal carina, and occasionally there is a slight depression in the center of the propodeum for its entire length. Propodeum rugose; fimbria prominent.

Abdomen equal to or slightly longer than head and thorax combined; segment 2 about equals 3 and 4 combined; 3 and 4 subequal; 5 and 6 subequal and each longer than 3 or 4.

Legs black, except at knees, which are testaceous.

Antennae: First funicle plus ring-joint one and one-half times as long as pedical; none of funical joints quadrate; club joints not quadrate and about same width as funicle joints. Scape black. Species large.

Male (pl. 48, fig. 6).—Praescutum same as in female; pronotal spots large, occupying about one-half anterior dorsal margin of prothorax and bright in color.

Propodeal groove incomplete and propodeum rugose.

Petiole about two-thirds length of hind coxae and about one and one-half times as long as broad.

Legs black, except knees, which are testaceous.

Antennae: Flagellum and pedicel together shorter than head, thorax and petiole combined; hairs on first joint about same length as apical joint of antennae; prominent spur at tip of apical joint which is about four times as long as broad. Scape broadest near center, about twice as broad as first flagellar joint and one-third as broad as long, exclusive of last. Three to five annulations at the articulation of all flagellar joints except at distal extremity of the first and second when there is one.

Redescribed from many specimens from cage rearings, from specimens reared from rye collected in Indiana, Ohio, and Pennsylvania, and from the type in the United States National Museum. It is also known to occur in California and Illinois.

This species inhabits the center of the stem and breeds only in rye. It is normally thelyotokous, males very rarely occurring.

HARMOLITA ALBOMACULATA Ashmead.

Plate 40, fig. 8; plate 43, figs. 3, 4; plate 45, fig. 17; plate 48, fig. 5.

Isosoma albomaculatum ASHMEAD, Trans. Amer. Ent. Soc., vol. 21, p. 329, 1894.

Female.—Praescutum reticulately lineolate and without broad impressions, except occasionally a few small shallow ones. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of prothorax.

Propodeum with or without groove. If groove is present there are prominent rugae within and it may be either rugose or granulose laterad of groove. Spiracular carinae prominent. If groove is not continuous there is a beginning anteriorly and the prominent carinae curve around to the spiracles. Propodeum may be granulose or rugose and may be slightly depressed down center; there is often a median carina. Fimbria rather prominent.

Abdomen equal to or shorter than head and thorax combined and rather stout. Segment 2 about equals 3 and 4 combined; 3, 4, 5, and 6 subequal; 3 usually shortest and 7 longest.

Legs black except at knees which are testaceous.

Antennae: First funicle joint plus ring-joint plainly longer than pedicel; all the funicle joints distinctly longer than broad; club joints slightly longer than broad and distinctly broader than funicle. Scape black. Species ranges from very small to medium.

Male (pl. 48, fig. 5).—Praescutum same as in female. Pronotal spots large, bright, occupying about one-half anterior dorsal margin of the prothorax.

Propodeal groove usually incomplete, occasionally complete; usually granulose within and laterad of groove.

Legs: Black except at knees and distal one-third of front femora; knees and distal one-third of front femora testaceous.

Antennae: Flagellum and pedicel longer than head, thorax, and petiole combined. Hair on first joint of flagellum distinctly longer than last joint of antennae. Spur on distal joint of flagellum scarcely twice as long as broad. Scape broadest near base and twice as broad as first flagellar joint. Four or more annulations at all articulations of flagellum. Scape scarcely three times as long as broad, exclusive of base.

Redescribed from specimens reared in cages under artificial conditions, and from specimens reared from stems of timothy collected in the Dakotas, Nebraska, Kansas, and from many States east of the Mississippi River, including New England; and from the types in the United States National Museum in Washington.

It inhabits the center of the stem and breeds only in timothy (*Phleum pratense*). It probably occurs wherever timothy is grown, except possibly in the irregated districts of the West. Males normally occur.

HARMOLITA CAPTIVA Howard.

Plate 39, fig. 9; plate 43, fig. 5; plate 45, fig. 11; plate 47, fig. 6.

Isosoma captivum HOWARD, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 13, 1896.

Female.—Praescutum roughly reticulately lineolate and bearing numerous broad, very shallow, impressions. Pronotal spots small but very distinctly visible from above.

Propodeum with very narrow, deep, continuous, median, longitudinal groove, which contains numerous cross rugae that are quite regularly spaced; rugose laterad of groove; spiracular carinae prominent; fimbria not prominent.

Abdomen longer than thorax. Segment 2 about one-third as long as abdomen exclusive of segment 1; greatest vertical diameter of the abdomen is at the third segment.

Legs: Femora black except at distal extremities which are testaceous; the front tibia and the extremities of the other tibia are testaceous; other parts of the tibia are fuscous.

Antennae: First funicle plus ring-joint usually only slightly longer than pedicel; none of the funicle or club joints quadrate and all of the flagellar joints the same width; scape about the same length as the first funicle joint and pedicel combined; scape black.

Species medium in size.

Male (pl. 47, fig. 6).—Praescutum same as in female and bears numerous broad and very shallow impressions. Pronotal spots minute but visible from above.

Propodeal groove complete with numerous cross rugae; rugose laterad of groove.

Petiole broader than coxae and one and one-half times as long as broad.

Legs black except at knees which are testaceous; front tibiae fuscous.

Antennae: Flagellum and pedicel shorter than head and thorax combined; hairs on first joint of flagellum shorter than apical joint of antennae; scape distinctly broadest at center and nearly three times as long as broad exclusive of base; 1 or 2 annulations at each articulation of the flagellum; prominent spur at end of apical joint of antennae. Scape slightly broader than first flagellar joint.

Redescribed from five females and two males reared from galls in the stems of blue grass collected at Richmond, Indiana, by the senior writer and from the types in the United States National Museum. It is also recorded from Norman, Illinois, and La Fayette, Indiana, by Dr. L. O. Howard and Prof. F. M. Webster.

This species makes inconspicuous galls near the base of the seed stalks of blue grass and has been reared only from this grass (*Poa pratensis*). Males normally occur.

HARMOLITA POAE, new species.

Plate 39, fig. 10; plate 43, fig. 6; plate 45, fig. 18; plate 47, fig. 1.

Female.—Length 2.5 mm. Praescutum reticulately lineolate with occasional small, very shallow impressions. Pronotal spots very small, scarcely visible from above.

Propodeum with a narrow, deep, continuous, margined, median, longitudinal groove, which has numerous cross rugae; slightly rugose or occasionally granulose laterad of groove. The groove is sometimes shallow and not always well defined; there are sometimes several longitudinal carinae within the groove; spiracular carinae usually prominent; fimbria not prominent.

Abdomen usually distinctly shorter than thorax; segment 2 one-third to one-half as long as the entire abdomen (dorsally) exclusive of segment 1. The greatest vertical diameter of abdomen is sometimes at fifth segment; abnominal segments vary greatly in length.

Legs black except at knees and anterior face of front femora which are testaceous.

Antennae: First funicle plus ring-joint almost twice as long as pedicel; none of funicle or club joints quadrate; flagellar joints about the same width throughout; the club joints are sometimes slightly narrower than the other joints; scape shorter than first funicle joint and pedicel combined; scape black.

Species medium in size.

Male (pl. 47, fig. 1).—Length 2 mm. Praescutum same as in female. Pronotal spots minute, not visible from above.

Propodeal groove may be complete or incomplete; propodeum either granulose or rugose.

Petiole about one and one-half times as long as broad.

Legs black except at knees, which are testaceous; front tibiae are fuscous.

Antennae: Flagellum and pedicel shorter than head and thorax combined; hairs on first joint or flagellum as long as the last joint of antennae; end of apical joint of antennae has a conspicuous broad and long spur; scape is distinctly broadest near the distal extemity and is one-half as broad as long exclusive of base; 2 to 4 annulations at the articulation of all flagellar joints except at the distal extremity of the penultimate where there are none. Scape nearly twice as broad as first flagellar joint.

Type-locality.—La Fayette, Indiana.

Type.—Cat. No. 21755, U. S. N. M.

Described from many females and males reared in cages under artificial conditions and from specimens reared from stems of blue grass collected at Richmond and La Fayette, Indiana, by the senior writer.

This species inhabits the center of the stem and has been reared only from the seed stalks of blue grass (*Poa pratensis*). It probably occurs wherever blue grass grows normally. Males normally occur.

HARMOLITA DACTYLICOLA, new species.

Plate 40, fig. 7; plate 43, fig. 7; plate 45, fig. 16; plate 48, fig. 4.

Female.—Length 3.0 mm. Praescutum reticulately lineolate with numerous broad, irregular, shallow impressions, rarely without them. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of prothorax.

Propodeum with a distinct, continuous, medium, longitudinal, margined groove, which is slightly broader posteriorly and contains numerous strong cross rugae; there is often an indication of a central carina; area laterad of groove usually rugose though sometimes granulose; spiracular carinae usually prominent; fimbria rather prominent.

Abdomen usually longer than head and thorax combined; segment 2 usually longer than 3 and 4 combined; 3, 4, 5, and 6 subequal, though 3 usually shortest and 7 usually longest; abdomen quite pointed as seen laterally.

Legs black except at knees which are testaceous.

Antennae: First joint of funicle plus ring-joint usually nearly twice as long as pedicel; all of funicle and club joints distinctly longer than broad; club joints same width as funicle. Scape black.

Species medium in size.

Male (pl. 48, fig. 4).—Length 2.0 mm. Praescutum as in female. Pronotal spots large, bright, occupying one-third to one-half anterior dorsal margin of prothorax.

Propodeum with a complete groove; rugose within and laterad of groove.

Petiole about twice as long as broad, is three-fourths length of hind coxae.

Legs black. except distal one-third of front femora and knees which are testaceous.

Antennae: Flagellum with pedicel equal to head and thorax combined; hairs on the first joint of flagellum distinctly longer than the last joint of antennae; last joint bears a short tubercle which is about twice as long as broad. Scape exclusive of base, one-third as broad as long as seen in lateral profile; is broader in basal half than in distal; no distinct shoulder in distal extremity; distinctly broader than first joint of flagellum. There may be from one to three annulations or indications of such at each articulation of the flagellum.

Type-locality.—Front Royal, Virginia.

Type.—Cat. No. 21756, U.S.N.M.

Described from many females and males reared in cages under artificial conditions and from specimens reared from orchard grass (*Dactylis glomerata*) collected in Indiana, Ohio, New York, Michigan, Pennsylvania, and Virginia.

This species inhabits the center of the stem and breeds only in orchard grass. Males normally occur.

HARMOLITA ELYMI French.

Plate 39, fig. 3; plate 43, fig. 8; plate 45, fig. 21.

Isosoma elymi French, Can. Ent., vol. 14, p. 9, 1882.

Isosoma elymi (French) Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 14, 1896.

Female.—Praescutum reticulately lineolate and occasionally with a few small shallow impressions. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of prothorax.

Propodeum with a distinct, narrow, continuous, median, longitudinal, margined groove, which contains numerous cross rugae; marginal carinae usually parallel and regular; the spiracular carinae prominent. There is a shield-shaped granulose area (rarely rugose) laterad of groove; fimbria not prominent.

Abdomen equal to or shorter than head and thorax combined; segment 2 almost equal to 3, 4, and 5 combined, occupying nearly one-third of the entire dorsal surface; 3, 4, and 6 subequal.

Legs black except at knees which are testaceous.

Antennae: First funicle plus ring-joint one and one-half times as long as pedicel; none of the funicle joints quadrate; club joints not quadrate and about the same width as funicle joints. Scape black.

Species ranges from small to medium in size.

Males.—Unknown.

Redescribed from many females reared in cages under artificial conditions and from specimens reared from stems of species of *Elymus* from practically all over the United States, and from the type in the United States National Museum.

This species inhabits the center of the stem and breeds only in spurs of *Elymus*. It probably occurs wherever *Elymus* normally grows. It is normally thelyotokous, males never having been observed.

HARMOLITA BROMICOLA Howard.

Plate 40, fig. 6; plate 43, fig. 9; plate 45, fig. 6.

Isosoma bromicola HOWARD, U. S. Dept. Agr., Div. Ent., Bull. tech, ser. No. 2, p. 18, 1896.

Howard's original description is as follows:

> *Female.*—Length 3.1 mm.; expanse, 4.6 mm. Punctuation of head, pronotum, and mesonotum (praescutum) like that of *H. maculata*, which it also resembles in the large pronotal spots. Metanotum (propodeum) with a distinct, strongly emarginate, central, longitudinal groove, the space either side finely granulate, with occasional irregular carinae. Abdomen longer than thorax; segment 2 as long as 3, 4, and 5 together; 5 and 6 subequal. Antennae rather long and straight; pilose; joint 1 of funicle only slightly longer than joint 2; club not quite as long as three preceding joints together, strongly flattened from side. Face very slightly pilose; metanotal (propodeal) fimbria sparse. The whole insect is smaller, slenderer, and more delicate in appearance than any except *grandis* form *minuta*.
>
> *Male.*—Length, 1.9 mm.; expanse, 3.4 mm. Petiole short, not as long as first abdominal segment and scarcely as long as hind coxae; scape of antennae slightly widened; funicle joints very slightly rounded above and very slightly pedicellate; each more than twice as long as pedicel and each faintly constricted in middle; club divided into two pedicellate joints as with *H. captiva*. All legs black with light yellow knees.

Supplementary to Howard's description:

Female.—Praescutum reticulately lineolate, very smooth, almost as smooth as *H. grandis*. Pronotal spots very large, sometimes almost meeting on the anterior margin of the prothorax. Propodeum with a continuous narrow, shallow, margined, central, longitudinal groove; marginal carinae parallel and regular. There is a large semicircular granulose area laterad of groove. Abdomen about equal to head and thorax combined and is very slender lanceolate; segments irregular in length; 2 may equal 3, 4, and 5 combined or may only equal 3 and 4; segments 3 to 7 may gradually increase in length or they may be approximately the same length. Fimbria not prominent.

Legs: Femora black, knees testaceous, and tibia brownish-black.

Male.—Praescutum same as in female. Pronotal spots large, occupying one-half anterior dorsal margin of the prothorax. Propodeum with narrow, shallow, margined, median, longitudinal groove; slightly rugose laterad of groove. Abdomen very slender, sides almost parallel. Legs colored as in female. Antennae: Flagellum about as long as head and thorax combined.

This supplementary description is based on the types in the United State National Museum. Males normally occur.

HARMOLITA MACULATA Howard.

Plate 39, fig. 8; plate 42, fig. 2; plate 43, fig. 10; plate 45, fig. 14; plate 47, fig. 7.

Isosoma maculatum HOWARD, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 15, 1896.

Female.—Praescutum reticulately lineolate and without (rarely with a few) any broad shallow impressions. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of the prothorax.

Propodeum with a distinct narrow continuous, median, longitudinal, margined groove, which has numerous cross rugae and usually an indication of a central carina; spiracular carinae not inconspicuous though they are not usually prominent; area laterad of groove rugose, rarely granulose; fimbria not prominent.

Abdomen shorter than head and thorax combined; segment 2 longer than 3 and 4 combined; 7 usually shorter than 6; 3 usually as long as either.

Legs black except at knees which are testaceous.

Antennae: First joint of funicle plus ring-joint much longer than pedicel; neither club nor funicle joints quadrate; club slightly broader than funicle; scape black.

Species ranges from minute to medium in size.

Male (pl. 47, fig. 7).—Praescutum as in female. Pronotal spots small but visible from above, occupying less than one-half of the anterior dorsal margin of the prothorax.

Propodeal groove usually complete; propodeum rugose laterad of and within the groove; often there is no complete groove and the propodeum is often granulose.

Legs black except at knees which are testaceous.

Antennae: Flagellum and pedicel shorter than head, thorax, and petiole combined; hairs on the first joint of flagellum same length as the last joint of antennae. The last joint of the antennae ends in a long conical spur, about four times as long as broad; scape broadest near the center and distinctly broader than first flagellar joint; two to four annulations at the articulation of all flagellar joints except the distal extremity of the penultimate joint which has only one. Scape scarcely three times as long as broad, exclusive of base.

Redescribed from females and males reared in cages under artificial conditions, and from specimens reared from stems of species of *Bromus* collected from many of the States east of the Mississippi River, and from the type in the United States National Museum. The males heretofore never have been described.

This species inhabits the center of the stem and breeds only in cheat (*Bromus secalinus*) and other species of *Bromus*. It probably occurs wherever *Bromus* grows, which is pretty much all over the United States. It has proven to be arrhenotokous under control conditions though in nature both sexes regularly occur.

HARMOLITA AGROPYROPHILA, new species.

Plate 39, fig. 7; plate 43, fig. 11; plate 45, fig. 19; plate 47, fig. 8.

Female.—Length 2.5 mm. Praescutum reticulately lineolate and usually without broad shallow impressions. Pronotal spots large, occupying from one-half to two-thirds anterior margin of the prothorax.

Propodeum with a distinct, narrow, continuous, median, margined, longitudinal groove, which contains numerous cross rugae; spiracular carinae often weak and not prominent and spiracular area often not well defined; area laterad of groove rugose and occasionally granulose; fimbria not prominent.

Abdomen shorter than head and thorax combined; segment 2, sometimes as long as 3, 4, and 5 combined and occupies about one-third the length of the entire dorsal surface; 7 usually longer than 6; 3 always shorter than 7.

Legs black except at knees which are testaceous.

Antennae: First funicle joint plus ring-joint usually only slightly longer than pedicel; neither club nor funicle joints quadrate; club joints broader than funicle. Scape black.

Species ranges from minute to medium in size.

Male (pl. 47, fig. 8).—Length 2 mm. Praescutum as in female. Pronotal spots small but visible from above, occupying less than one-half the anterior dorsal margin of the prothorax and are bright.

Propodeum either rugose or granulose, with or without a continuous groove.

Petiole nearly twice as long as broad.

Legs black except at knees which are testaceous.

Antennae: Flagellum and pedicel shorter than head, thorax and petiole combined; halves on first joint of flagellum same length as the last joint of antennae. Last joint ends in a rather conspicuous spur, which may vary from 2 to 4 times as long as broad; scape distinctly broadest near base and much broader than the first flagellar joint; there are from 3 to 5 annulations at the articulation of the joints of the flagellum. Scape, exclusive of base, scarcely three times as long as broad.

Type-locality.—Charlottesville, Virginia.

Type.—Cat. No. 21757, U.S.N.M.

Described from many females and males reared in cages under artificial conditions and from specimens reared from stems of species of *Agropyron* collected in eastern Kansas, Indiana, Ohio, Michigan, New York, and Pennsylvania.

This species inhabits the center of the stem and breeds only in species of *Agropyron*. Males normally occur.

HARMOLITA TRITICI Fitch.

Plate 41, fig. 4; plate 42, fig. 1; plate 44, fig. 1; plate 45, fig. 12; plate 47, fig. 4.

Eurytoma tritici Fitch, Journ. N. Y. State Agr. Soc., vol. 10, p. 115, 1859.

Isosoma nigrum Cook, Rural New Yorker, p. 814, June, 1885.

Isosoma tritici (Fitch) Howard, U. S. Dept. Agr., Div. Ent. Bull. tech. ser. No. 2, p. 17, 1896.

Female.—Praescutum rugulose. Pronotal spots minute to small, visible from above, occupying scarcely one-fourth anterior dorsal margin of prothorax.

Propodeum without a continuous, median, longitudinal groove, although there is a trace of a groove in the anterior one-third the margined carinae of which curve around the spiracles. There is also a well-defined central carina the full length of this groove. Prododeum very rugose, the rugae extending in a more or less longitudinal direction; fimbria not prominent.

Abdomen longer than head and thorax combined; segment 2 about one-fifth the length of the abdomen (dorsally) exclusive of first segment; 3 shortest, 5 longest; 4 and 6 subequal and each longer than 7.

Legs: Knees and front tibiae are testaceous; basal half of front femora, middle and hind femora and tibiae black, although the middle and hind tibiae are occasionally somewhat fuscous.

Antennae: First funicle plus ring-joint the same length or only slightly longer than pedicel; none of funicle or club joints quadrate; club joints same width as funicle; scape black.

Species large in size.

Male (pl. 47, fig. 4).—Praescutum same as in female. Pronotal spots not visible from above when head is in normal position.

Propodeum with or without a groove; when present, the groove is broad and shallow; propodeum rugose.

Petiole two-thirds length of second abdominal segment and three-fourths to about equal to the hind coxae; rugose to granulose.

Legs black except at knees and front tibia, which are brown to dusky.

Antennae: Flagellum with pedicel shorter than head and thorax combined. Scape as seen in lateral profile about the same width throughout and is broader than the first flagellar joint; near distal extremity there is a distinct shoulder; four times as long as broad exclusive of base.

Redescribed from many females and males reared in cages under artificial conditions and from specimens reared from wheat stubble collected in the field in the States of Missouri, Illinois, Indiana, Ohio, Michigan, New York, Pennsylvania, Maryland, Kentucky, Tennessee, Virginia, and West Virginia, and from the types in the United States National Museum.

This species makes conspicuous hardened enlargements or galls in wheat stems, usually about the second or third internode from the base of the plant, though they may occur at every internode. It breeds only in wheat and has proven to be arrhenotokous under control conditions, though both sexes regularly occur in nature.

HARMOLITA HORDEI Harris.

Plate 41, fig. 5; plate 44, fig. 6; plate 46, fig. 8; plate 48, fig. 7.

Ichneumon hordei Harris, New England Farmer, vol. 9, p. 2, July 23, 1830.

Eurytoma fulvipes Fitch, 7th Rept. Ins. N. Y. (sep. ed.), p. 154, 1862.

Eurytoma flavipes Fitch, 7th Rept. Ins. N. Y., p. 159, 162, 1862.

Isosoma hordei Walsh, Amer. Ent., vol. 2, p. 330, Oct., 1870.

Isosoma hordei (Harris) Howard, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 18, 1896.

Female.—Praescutum rugulose. Pronotal spots minute, not visible from above; frequently there is only a trace.

Propodeum without a distinct groove, though there is frequently a slight depression down the center and there is often a median longitudinal carina.

Abdomen is distinctly longer than head and thorax combined; segment 2 a little over one-fifth the length of the abdomen, exclusive of one; 3 the shortest, 5 longest; 4, 6, and 7 subequal.

Legs a translucent reddish-brown, though occasionally specimens may have all the legs dusky, the tibiae being testaceous.

Antennae: First funicle plus ring-joint only slightly longer than pedicel; all joints longer than broad; club slightly broader than funicle; scape brownish, flagellum black.

Species medium to large in size.

Male (pl. 48, fig. 7).—Praescutum as in female. Pronotal spots minute, not visible from above.

Propodeum rugose, without a groove.

Petiole about one-half the length of hind coxae; rugose to granulose.

Legs: Tibiae and tarsi reddish-brown; front and middle femora vary from black in basal half to reddish-brown, being always reddish-brown in distal half; hind femora black to dusky except at knees, which are light brown.

Antennae: Flagellum with pedicel shorter than head and thorax combined; scape as seen in lateral profile about same width throughout and is about equal in width to first flagellar joint; shoulder near distal extremity of scape not conspicuous; nearly 5 times as long as broad, exclusive of base. Scape brownish.

Redescribed from many females reared in cages under artificial conditions, from specimens reared from barley stubble collected at Auburn and Little Falls, New York, by the senior writer, from Harris's type in Boston Society of Natural History and from Fitch's *Eurytoma fulvipes* in the collection of the United States National Museum.

This species is a gall former, making conspicuous hardened enlargements above the second to fourth nodes in barley straw. It breeds only in barley, and is normally thelyotokous, males rarely occurring.

Walsh reared a number of specimens from barley straw sent to him from Canada[1] and stated that he found Fitch's *tritici* and *secalis* and Harris's *hordei* among them, basing his identification upon the coloration of the legs. He therefore considered *tritici* Fitch and *secalis* Fitch to be synonyms of *hordei* Harris. He undoubtedly had *H. hordei* Harris before him at the time.

HARMOLITA RUFIPES, new species.

Plate 40, fig. 1; plate 44, fig. 2; plate 46, figs. 7, 11.

Female.—Length 4 mm. Praescutum rugulose. Pronotal spots small, occupying one-half or less of the anterior dorsal margin of prothorax.

Propodeum with a continuous, narrow, deep, margined, median, longitudinal groove with numerous cross rugae; marginal carinae of groove irregular, often interrupted.

Abdomen usually distinctly longer than head and thorax combined; segment 3 shortest, 5 longest; 4 and 7 subequal; 6 frequently longer than either; segment 2 from one-sixth to one-fourth the length of the abdomen (dorsally) exclusive of 1.

Legs a translucent to opaque reddish-brown.

Antennae: First funicle plus ring-joint longer than pedicel; none of funicle or club joints are quadrate; club about same width as the three preceding joints. Scape black.

Species large to very large in size.

Male (pl. 46, fig. 7).—Length 3.0 mm. Praescutum as in female. Pronotal spots small, occupying less than one-half anterior dorsal margin of prothorax.

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[1] Amer. Ent., vol. 2, p. 330, October, 1870.

Propodeum with a complete, deep, narrow groove; propodeum rugose.

Petiole about the same length as hind coxae.

Legs a translucent to opaque reddish-brown.

Antennae: Flagellum with pedicel equal to head and thorax combined; scape as seen in lateral profile broadest distally; three times as long as broad exclusive of base; at broadest place about twice as broad as first flagellar joint; near distal extremity there is a distinct shoulder.

Type-locality.—Champaign, Illinois.

Type.—Cat. No. 21758, U.S.N.M.

Described from many females and males reared from stems of species of *Elymus* collected by the late Prof. F. M. Webster in Illinois; in Kansas and Nebraska by Mr. G. I. Reeves; in Utah by Mr. T. H. Parks; and in New Mexico by Mr. C. N. Ainslie.

H. rufipes makes or forms inconspicuous galls in the internode just below the head. There is often no external enlargement of the stem where the galls occur. It has been reared only from species of *Elymus*. Males normally occur.

HARMOLITA FESTUCAE, new species.

Plate 41, fig. 10; plate 43, fig. 14; plate 45, fig. 10; plate 46, fig. 12.

Females.—Length 3.5 mm. Praescutum densely rugulose. Pronotal spots small, occupying one-half or less of the anterior dorsal margin of prothorax.

Propodeum with a continuous, moderately broad, deep, median, longitudinal groove, usually margined throughout. Occasionally there is a median longitudinal ruga anteriorly, extending about one-half the length of the groove; rugose within and laterad of groove.

Abdomen long and very slender, plainly longer than head and thorax combined, very narrowly lanceolate; segment 2 between one-sixth and one-seventh the length of the abdomen. Segment 3 is shortest, 5 longest; 6 approaches 5 in length and is usually longer than 4 or 7; segment 7 is never shorter than 4.

Legs: Basal one-half of upper and lower and basal one-third of anterior and posterior faces of front, basal one-half of middle and basal two-thirds of hind femora, black to fuscous; middle and hind tibiae fuscous, front tibiae and knees testaceous.

Antennae: First funicle plus ring-joint equals pedicel in length; scape exclusive of base equals pedicel plus first 2 joints of funicle; fifth funicle joint quadrate and first and second club joints broad as long; club slightly broader than 3 preceding joints. Scape black.

Species medium to large in size.

Male (pl. 46, fig. 12).—Length 2.25 mm. Praescutum same as in female. Pronotal spots visible from above, occupying nearly one-third of anterior dorsal margin of prothorax.

Propodeum coarsely rugose, with a distinct median groove.

Petiole about twice as long as broad; about the same length as hind coxae and granulose; slightly constricted just back of anterior margin, which is slightly enlarged.

Legs: Knees, front tibiae, and distal half of front femora brownish, remaining parts black.

Antennae: Flagellum with pedicel shorter than head and thorax combined. Scape as seen in lateral profile about same width throughout and about 8 times as long as broad, exclusive of base; no shoulder distally; about same width or narrower than first flagellar joint.

Type-locality—Charlottesville, Virginia.

Type—Cat. No. 21759, U.S.N.M.

Described from many females reared in cages under artificial conditions and from specimens reared from stems of species of *Festuca* collected at Penn Yan, New York, Youngstown, Ohio, and Staunton, Virginia.

This species makes conspicuous hardened enlargements or galls in the second to fourth internode from the base of the plants. It breeds only in species of *Festuca* and is normally thelyotokous, males rarely occurring.

HARMOLITA VAGINICOLA Doane.

Plate 41, fig. 3; plate 43, fig. 13; plate 46, fig. 13.

Isosoma vaginicolum DOANE, Journ. Econ. Ent., vol. 9, No. 4, p. 398, Aug. 1916.

Female.—Praescutum rugulose. Pronotal spots small, occupying about one-half or less of the anterior dorsal margin of prothorax.

Propodeum with a distinct, very broad, shallow, margined, median, longitudinal groove. Groove broadest near center; marginal carinae are frequently interrupted; floor of groove with an occasional ruga in the anterior one-third to one-half; posteriorly usually quite rugose; propodeum rugose laterad of the groove. No distinct spiracular carinae. Fimbria prominent.

Abdomen longer than head and thorax combined; segment 2 about one-fifth the length of the abdomen exclusive of 1; 4, 5, 6, and 7 are subequal, though 4 is usually longer than 6.

Legs: Knees, distal half of upper and two-thirds of lower face of front femora, and front tibiae testaceous; basal half of front femora, middle and hind femora, and tibiae black, though occasionally the middle and hind tibiae appear slightly fuscous.

Antennae: First funicle plus ring-joint distinctly longer than pedicel. All of funicle and club joints distinctly longer than broad; the club slightly broader than the 3 preceding joints. Scape brownish.

Species medium in size.

Male.—Unknown.

Redescribed from many females reared in cages under artificial conditions; from specimens reared from galls in wheat stubble that was collected from several localities in New York, Ohio, Pennsylvania, also from Michigan and Salt Lake City, Utah; from specimens identified for the writers by Prof. R. W. Doane; from specimens in the Harris collection of the Boston Society of Natural History that were collected in Virginia in 1852 and labeled *Isosoma tritici;* from five specimens in the United States National Museum collection bearing the label, Verdun, Ontario, Canada; also five females in the National Museum collection labeled with the manuscript name, "*Pteromalus hordei* Harris" from Virginia, numbered 3786 to 3790. This shows conclusively that this species was often confused by earlier writers with *H. tritici*, and if all the old types were in existence it would undoubtedly be found that some represent this species.

This species is a gall former, making a conspicuous hardened enlargement in the sheath surrounding the head of wheat. The head rarely grows out of the sheath and rarely does the head develop any grain. It breeds only in wheat and is normally thelyotokous, males never having been observed.

HARMOLITA SECALIS Fitch.

Plate 41, fig. 7; plate 43, fig. 12; plate 46, figs. 5, 14.

Eurytoma secale FITCH, Amer. Agr., vol. 20, p. 236, Aug., 1861.

Isosoma secale (Fitch) HOWARD, U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 19, 1896.

Female.—Praescutum rugulose. Pronotal spots range from small to large, occupying less than one-half to two-thirds anterior dorsal margin of prothroax.

Propodeum with a very broad, shallow, median, longitudinal groove. Groove broadest near the center, rarely distinctly margined posteriorly; usually granulose within and laterad of groove; sometimes quite rugose laterad of groove; low cross rugae sometimes within the groove; spiracular carinae usually interrupted, low and indistinct; fimbria prominent.

Abdomen equal to or slightly longer than head and thorax combined; segment 2 about one-fifth the length of abdomen exclusive of 1; 3 shortest, 5 longest; 4, 6, and 7 subequal; 4 may be either longer or shorter than 6 or 7.

Legs: Femora in basal one-half to two-thirds and middle tibiae fuscous; front tibiae, knees, and hind tibiae testaceous; middle tibiae as a rule are a shade darker.

Antennae: First funicle plus ring joint equal to or slightly longer than pedicel; all joints of funicle and club distinctly longer than road; club narrower than the 3 preceding joints. Scape black.

Species medium to large in size.

Male (pl. 46, fig. 5).—Praescutum same as in female. Pronotal ots minute, scarcely visible from above.

Propodeum without groove and rugose.

Petiole about one-half the length of hind coxae and with low rugae.

Legs: Femora black, except at knees; tibia dusky; knees testaceous.

Antennae: Flagellum with pedicel shorter than head and thorax combined; scape as seen in lateral profile about same width throughout and same width as first flagellar joint; very slight shoulder distally; scape, exclusive of base, one-fifth as broad as long.

Redescribed from many females reared in cages under artificial conditions, and from specimens reared from galls in rye stubble collected at Warsaw and La Fayette, Indiana, and from the types in the United States National Museum.

This species makes conspicuous hardened enlargements of galls usually in the second or third internodes from the base of the plant. It breeds only in rye and is normally thelyotokous. Males very rarely occur.

HARMOLITA HESPERUS, new species.

Plate 40, fig. 4; plate 44, fig. 5; plate 46, fig. 15; plate 47, fig. 3.

Female.—Length 3.75 mm. Praescutum rugulose. Pronotal spots large, occupying two-thirds or more of anterior dorsal margin of prothorax.

Propodeum with a narrow, deep, median, longitudinal groove; marginal carinae very often interrupted and irregular, and there are numerous cross rugae within the groove; area laterad of groove very rugose. Fimbria very inconspicuous.

Abdomen distinctly longer than head and thorax combined; segment 2 from one-fifth to one-fourth the length of the abdomen exclusive of 1; 3 shortest, 5 longest; 4 and 7 subequal; 6 usually longer than either 4 or 7.

Legs: Front femora, distal two-thirds of middle and one-half of hind femora, and all tibiae translucent reddish-brown; basal part of middle and hind femora fuscous.

Antennae: First funicle plus ring-joint distinctly longer than pedicel; none of funicle or club joints quadrate; club joints same width as fifth funicle; scape dusky to black.

Species medium to very large in size.

Male (pl. 47, fig. 3).—Length 2.5 mm. Praescutum same as in female. Pronotal spots occupying one-third to one-half anterior dorsal margin of prothorax and are often obscure.

Propodeal groove deep and usually well defined throughout. Propodeum very rugose.

Petiole about same length as hind coxae; finely rugose to granulose.

Legs: Front legs, tibiae, distal two-thirds of middle femora and sometimes apical one-third of hind femora reddish-brown; occasionally the middle femora are reddish-brown throughout; basal one-third of middle and basal two-thirds of hind femora are dusky.

Antennae: Flagellum and pedicel slightly longer than head and thorax combined; scape in lateral profile slightly broader than first flagellar joint; slightly broader at distal extremity, where there is a distinct shoulder; one-third as broad as long exclusive of base.

Type-locality.—Holliday, Utah.

Type.—Cat. No. 21760, U.S.N.M.

Described from many females and males reared from stems of species of *Elymus* collected in Utah by Mr. T. H. Parks, the Dakotas, Nebraska, and Kansas, by Mr. George I. Reeves.

This species is a gall former, making galls in species of *Elymus* very much like those of *H. rufipes.* It has only been reared from species of *Elymus.* Males normally occur.

HARMOLITA AGROPYROCOLA, new species.

Plate 41, fig. 2; plate 44, fig. 9; plate 45, fig. 9.

Female.—Length 3.0 mm. Praescutum rugulose. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of prothorax.

Propodeum with continuous, deep, narrow, margined, median, longitudinal groove; floor of groove in anterior region sometimes almost smooth but with numerous cross rugae in the posterior region; very rugose laterad of groove.

Abdomen slightly longer than head and thorax combined; segments vary in length.

Legs: All tibiae, front femora (except occasionally in basal region) and distal one-half to one-fourth of middle and hind femora reddish-brown; basal portion of femora dusky.

Antennae: First funicle plus ring-joint about equal in length to pedicel; fifth funicle joint about as broad as long as seen dorsally; club slightly broader than funicle and first 2 joints as broad as long; scape black.

Species medium sized.

Males.—Unknown.

Type-locality.—Salt Lake City, Utah.

Type.—Cat. No. 21761, U.S.N.M.

Described from five females reared from stems of species of *Agropyron* collected near Salt Lake City, Utah, by Mr. Desla Bennion. This species is a gall former in species of *Agropyron.* Males have never been observed.

HARMOLITA OVATA, new species.

Plate 40, fig. 3; plate 44, fig. 7; plate 45, fig. 5; plate 48, fig. 3.

Female.—Length 3.0 mm. Praescutum rugulose. Pronotal spots large, occupying two-thirds anterior dorsal margin of prothorax.

Propodeum with a deep, narrow, margined, median, longitudinal groove, which is narrower posteriorly; the marginal carinae much more prominent anteriorly and the groove often without rugae anteriorly; very rugose laterad of groove.

Abdomen broadly ovate and equal in length to head and thorax combined, though at first glance it may appear shorter; segment 2 about one-fourth the length of the abdomen exclusive of segment 1; 3 usually shortest and 5 longest; 3, 6, and 7 sometimes equal in length; 4 never shorter than 6 or 7; 6 and 7 usually equal.

Legs: Basal one-third to one-half of upper and lower faces of front femora dusky, anterior and posterior faces testaceous to reddish-brown; basal one-half to two-thirds of middle and basal two-thirds of hind femora fuscous; the remaining portions of femora and all tibia reddish-brown. Sometimes the front femora show very little duskiness.

Antennae: First funicle plus ring-joint about equal in length to pedicel; fourth funicle joint quadrate and fifth slightly broader than long; first 2 club joints quadrate; club only slightly broader than funicle. Scape black.

Species medium sized.

Male (pl. 48, fig. 3).—Length, 2 mm. Praescutum same as in female. Pronotal spots occupying one-third to one-half anterior dorsal margin of prothorax.

Propodeal groove deep anteriorly, complete; propodeum rugose within and laterad of groove.

Petiole about same length as hind coxae and is granulose.

Legs: Hind and middle femora black except at knees; front femora dusky to black except at knees; hind and middle tibiae dusky to black; front tibiae dusky to reddish-brown; knees testaceous.

Antennae: Flagellum and pedicel longer than head and thorax combined; scape as seen in lateral profile the same width throughout with a slight shoulder near the distal extremity; about same width as first funicle joint; one-fourth as broad as long, exclusive of base.

Type-locality.—Wellington, Kansas.

Type.—Cat. No. 21762, U.S.N.M.

Described from 10 females and 7 males reared from species of *Elymus* collected at Wellington, Kansas, by Mr. E. O. G. Kelly. It forms galls and has been reared only from species of *Elymus*.

HARMOLITA ELYMOXENA, new species.

Plate 39, fig. 6; plate 44, fig. 12; plate 45, fig. 1; plate 46, fig. 3.

Female.—Length 2.5 mm. Praescutum rugulose, Pronotal spots large, occupying two-thirds anterior dorsal margin of prothorax; usually dull and obscure.

Propodeum with a complete, narrow, shallow, margined, median, longitudinal groove, often much broader anteriorly; area laterad of groove very rugose, quite flat.

Abdomen equal to or slightly longer than head and thorax combined; segments vary considerably in length: fifth longest, 3 usually shortest.

Legs: Three-fourths of the upper and lower faces of front femora pale fuscous; middle and hind legs, except at knees, fuscous; front tibiae, lateral faces of front femora, and all knees luteous to testaceous.

Antennae: First funicle plus ring-joint slightly longer than pedicel; fifth funicle and first 2 club joints usually about quadrate. Scape black.

Species medium sized.

Male (pl. 46, fig. 3).—Length, 2 mm. Praescutum as in female. Pronotal spots obscured and may vary from not visible from above to visibly occupying one-third to one-half the anterior dorsal margin of prothorax.

Propodeum usually with a complete groove and may be either rugose or granulose within and laterad of groove.

Petiole one and one-half times as long as broad and about two-thirds length of hind coxae.

Legs fuscous except distal one-third of front femora and knees, which are testaceous; occasionally the front tibiae are testaceous.

Antennae: Flagellum with pedicel shorter than head and thorax combined; scape distinctly broader than first flagellar joint; one-third as broad as long in broadest place, exclusive of base, and has a distinct shoulder near distal extremity.

Type-locality.—Santa Cruz Mountains, California.

Type.—Cat. No. 21763, U.S.N.M.

Described from many females and males in the United States National Museum that were collected in California, under No. 4255, bearing the label "Reared from *Elymus americanus*"; also from specimens No. 547 that were collected in the Santa Cruz Mountains, California. All of these specimens were collected by Mr. Albert Koebele. As previously stated there are many males and females among this material.

HARMOLITA ELYMICOLA, new species.

Plate 40, fig. 9; plate 44, fig. 10; plate 45, fig. 4; plate 48, fig. 2.

Female.—Length, 3 mm. Praescutum rugulose. Pronotal spots very large, occupying about three-fourths anterior dorsal margin of prothorax.

Propodeum with a continuous, median, longitudinal groove, which may be either rather broad and shallow or narrow and deep, but always distinctly broader anteriorly; when groove is narrow and deep the middle and hind legs are very black. Propodeum usually granulose within and laterad of groove; sometimes rugose laterad of groove; cross rugae inconspicuous in anterior portion of groove.

Abdomen equal to or longer than head and thorax combined; segment 2 equals one-fifth to one-fourth the length of the abdomen exclusive of segment 1; 3 shortest; 4 to 7 vary greatly in length.

Legs: Basal one-half of upper faces of front, basal one-third of lower and basal two-thirds of upper faces of middle and the hind femora and middle and hind tibiae fuscous; front tibiae, all knees, and other portions of femora tectaceous.

Antennae: First funicle plus ring-joint longer than pedicel; none of the joints are quadrate; club slightly broader than the three preceding segments. Scape black.

Species medium to large in size.

Male (pl. 48, fig. 2).—Length, 2.5 mm. Praescutum as in female. Pronotal spots occupying one-half to two-thirds anterior dorsal margin of prothorax, and usually bright.

Propodeal groove deep anteriorly, generally complete; propodeum either granulose or rugose laterad of groove and within the posterior part of the groove.

Petiole not quite as long as hind coxae; granulose.

Legs: Front femora piceous in basal half; hind and middle legs piceous except at knees; front tibiae dusky to reddish-brown.

Antennae: Flagellum with pedicel about same length as head and thorax combined; scape distinctly broadest in distal half and near the distal extremity there is a distinct shoulder; distinctly broader than first flagellar joint; one-third as wide as long, exclusive of base.

Type-locality.—La Fayette, Indiana.

Type.—Cat. No. 21764, U.S.N.M.

Described from many females and males reared in cages under artificial conditions and from specimens reared from stems of species of *Elymus* collected in Indiana and Virginia.

This species makes very conspicuous galls usually at the second or third internode from the base of the plant and breeds only in species of *Elymus*. It has proven to be arrhenotokous under control conditions, but in nature both sexes regularly occur.

HARMOLITA ATLANTICA, new species.

Plate 39, fig. 1; plate 43, fig. 15; plate 46, figs. 2, 4.

Female.—Length 3 mm. Praecutum rugolose. Pronotal spots large, occupying about two thirds anterior dorsal margin of prothorax; often obscure or dull.

Propodeum with, rarely without, a continuous, broad, shallow, median, longitudinal groove; groove often margined only in its anterior half, though just as often it has marginal carinae throughout its entire length; propodeum rugose within and laterad of groove, though occasionally granulose; when without groove or when there is only a trace of groove the propodeum is granulose; groove usually broadest near center; entire floor of groove is rugose.

Abdomen quite slender, longer than head and thorax combined; second segment from one-fourth to one-fifth the length of the abdomen, exclusive of 1; 3 shortest, 5 longest; 4, 6, and 7 subequal; rarely 6 equals 5.

Legs: Basal one-third of all faces and two-thirds of upper face of front femora blackish, middle and hind legs black; front tibiae testaceous to dusky; knees testaceous.

Antennae: First funicle plus ring-joint as long as pedicel; segment 4 of funicle usually quadrate, rarely longer than broad; 5 often longer than broad; club joints scarcely quadrate. Scape black to brownish.

Species small to medium in size.

Male (pl. 46, fig. 2).—Length 1.5 mm. Praescutum as in female. Pronotal spots small, scarcely visible from above.

Propodeum granulose or rugose, with or without groove.

Petiole granulose, longer than wide, but not twice as long, about equal in length to hind coaxe.

Legs black, except at knees, which are dusky brown; ventral surface of front femora and front tibiae dusky brown.

Antennae: Flagellum with pedicel equal to or shorter than head and thorax combined; scape as seen in lateral profile about same width throughout and about four times as long as broad, exclusive of base; about same width as first flagellar joint; there is a distinct shoulder near distal extremity.

Type-locality.—Penn Yan, New York.

Type.—Cat. No. 21765, U.S.N.M.

Described from many females reared in cages under artificial conditions, and from specimens reared from stems of species of *Agropyron* collected in New York, Pennsylvania, Ohio, Indiana, and Michigan.

This species breeds only in species of *Agropyron*, in which it forms galls that are usually inconspicuous, but occasionally the galls are formed in the sheath that surrounds the head very much the same as the galls of *H. vaginicola*. *H. atlantica* is normally thelyotokous, males rarely occurring.

HARMOLITA ELYMOPHILA, new species.

Plate 41, fig. 1; plate 44, fig. 4; plate 45, fig. 8; plate 47, fig. 10.

Female.—Length, 3.0 mm. Praescutum rugulose. Pronotal spots very large, occupying three-fourths anterior dorsal margin of prothorax; they diffuse somewhat, giving the prothorax a brownish tint orsally and laterally.

Propodeum with a complete narrow, shallow, margined, median, longitudinal groove; marginal carinae very weak; groove almost smooth or quite rugose; laterad of groove usually quite convex and rugose, though occasionally granulose. The propodeum often has a brownish tint.

Abdomen slightly longer than head and thorax combined; it usually has a brownish tinge throughout; segment 5 longest; 4 usually longer than 6; 3 usually shorter than 4 or 7; 7 usually shorter than either 4 or 6.

Legs: Three-fourths of upper and lower faces of front femora pale fuscous; middle and hind legs, except at knees, fuscous; front tibiae, lateral faces of front femora and all knees luteous to testaceous.

Antennae: First funicle plus ring-joint about same length as pedicel; fifth joint of funicle quadrate except in few specimens; first two joints of club usually quadrate. Scape black.

Species medium in size.

Male (pl. 47, fig. 10).—Length, 2 mm. Praescutum as in female. Pronotal spots usually large, occupying about two-thirds anterior dorsal margin of prothorax; often somewhat obscure or dull, giving the anterior margin a brownish tint.

Propodeal groove usually complete; propodeum rugose except when groove is incomplete, in which case it is granulose.

Petiole shorter than hind coxae and about one and one-half times as long as broad.

Legs black except knees and distal portion of front femora (more especially on anterior faces) which are testaceous; sometimes legs are brownish-black; front tibiae usually dusky.

Antennae: Flagellum with pedicel equal to or shorter than head and thorax combined; scape distinctly broadest near distal extremity where there is a very prominent shoulder; scape distinctly broader than first flagellar joint. Scape, exclusive of base, three times as long as broad.

Type-locality.—Alameda, California.

Type.—Cat. No. 21766, U.S.N.M.

Described from many females and males in the United States National Museum that were collected in Alameda County, California, by Mr. Albert Koebele and bear his numbers 396 and 407. It makes inconspicuous galls in species of *Elymus*. Males normally occur.

HARMOLITA POOPHILA, new species.

Plate 41, fig. 9; plate 44, fig. 13; plate 46, fig. 6; plate 47, fig. 5.

Female.—Length, 2.5 mm. Praescutum rugulose. Pronotal spots large, occupying one-half to two-thirds anterior dorsal margin of prothorax.

Propodeum with narrow, deep, margined, median, longitudinal groove, which contains numerous cross rugae; propodeum very rugose laterad of groove.

Abdomen equal to head and thorax combined; segment 2 about one-fifth to one-fourth length of abdomen exclusive of 1; 3 shortest, 5 longest; 6 longer than either 4 or 7.

Legs: Basal half of upper and lower faces of middle and front, basal two-thirds of hind femora dusky to fuscous; front tibiae, and often portions of femora, and knees testaceous; middle and hind tibiae dusky to fuscous.

Antennae: First funicle plus ring-joint about equal to pedicel in length; none of funicle or club joints quadrate. Club about the same width as the three preceding joints. Scape black.

Species about medium in size.

Male (pl. 46, fig. 6).—Length, 2.25 mm. Praescutum as in female. Pronotal spots occupying one-third or less of anterior dorsal margin of prothorax, usually obscure or dull.

Propodeal groove narrow and deep throughout with marginal carinae and with several cross rugae within groove. Propodeum rugose to granulose laterad of groove.

Petiole equal in length to hind coxae and granulose.

Legs: Hind femora black; front and middle femora dusky in basal half; hind and middle tibiae dusky to black; front tibiae and knees testaceous.

Antennae: Flagellum with pedicel equal to or slightly shorter than head and thorax combined. Scape approximately same width throughout, with only a slight shoulder near the distal extremity; about four times as long as broad, exclusive of base.

Type-locality.—Husted, Colorado.

Type.—Cat. No. 21767, U.S.N.M.

Described from 4 females and 16 males that were reared from galls in *Poa lucida.* The stems bearing these galls were collected near Husted, Colorado, by Dr. A. D. Hopkins.

HARMOLITA ELYMIVORA, new species.

Plate 40, fig. 2; plate 44, fig. 3; plate 45, fig. 13; plate 47, fig. 9.

Female.—Length 3.4 mm. Praescutum rugulose. Pronotal spots large, occupying about two-thirds anterior dorsal margin of prothorax.

Propodeum with a continuous, narrow, deep, margined, median, longitudinal groove, marginal carinae irregular and often broken; propodeum rugose within and laterad of groove.

Abdomen longer than head and thorax combined; vertical diameter of sixth segment only slightly less than its greatest vertical diameter; second abdominal segment from one-sixth to one-fifth length of the abdomen; 3 shortest, 5 usually longest; 4, 6, and 7 subequal; 6 rarely shorter than 4 or 7, usually longer than either.

Legs: Basal two-thirds of upper and basal one-third of lower faces of front, basal one-half of middle femora, middle and hind tibiae fuscous; hind femora fuscous to piceous; front tibiae and all knees testaceous to dusky.

Antennae: First funicle plus ring-joint longer than pedicel; all funicle joints usually longer than broad; club joints also usually longer than broad and only slightly wider than funicle. Scape black.

Species medium to large in size.

Male (pl. 47, fig. 9).—Length, 2.0 mm. Praescutum as in female. Pronotal spots occupy about one-half anterior dorsal margin of prothorax, occasionally, however, scarcely visible from above.

Propodeal groove deep, complete. Propodeum very rugose within and laterad of groove.

Petiole about same length as hind coxae and rugose to granulose.

Legs: Hind and middle femora fusco-piceous except at knees; front femora fuscous in basal half; hind and middle tibiae fuscous to dusky; front tibiae and knees reddish-brown.

Antennae: Flagellum with pedicel equal to or longer than head and thorax combined. Scape distinctly broadest in distal half and there is a distinct shoulder near the distal extremity; about same width as first flagellar joint in lateral profile; a little over three times as long as broad, exclusive of base.

Type-locality.—Charlottesville, Virginia.

Type.—Cat. No. 21768, U.S.N.M.

Described from many females and males reared in cages under artificial conditions and from specimens reared from stems of species of *Elymus* collected in Arkansas, Kansas, Illinois, Indiana, Ohio, and in Virginia. It makes inconspicuous galls near the head of species of *Elymus*. Males normally occur.

HARMOLITA ELYMOPHTHORA, new species.

Plate 40, fig. 5; plate 44, fig. 14; plate 46, fig. 10; plate 47, fig. 2.

Female.—Length 3.25 mm. Praescutum rugulose. Pronotal spots large to very large, occupying two-thirds to three-fourths anterior dorsal margin of prothorax, sometimes dull.

Propodeum with a continuous, moderately narrow, deep, median, longitudinal groove, usually margined throughout, though sometimes only in the anterior one-half; very rugose laterad of groove and in the posterior half of groove; anterior half of groove almost smooth, though it may be slightly granulose; groove usually much narrower in posterior half.

Abdomen longer than head and thorax combined; segment 2 from one-sixth to one-fifth the length of the abdomen; 3 shortest, 5 longest; 4, 6, and 7 subequal; segment 4 usually not shorter than 7.

Legs: Basal half of middle and basal two-thirds of hind femora black; middle tibiae black to dusky; hind tibiae reddish-brown to dusky; front femora may be dusky in basal half, but are usually reddish-brown throughout; front tibiae and all knees may vary from testaceous to reddish-brown.

Antennae: First funicle plus ring-joint distinctively longer than pedicel; none of joints quadrate; club about same width as three preceding joints. Scape black.

Species medium to large in size.

Male (pl. 47, fig. 2).—Length 2.25 mm. Praescutum as in female. Pronotal spots occupy one-third to one-half anterior dorsal margin of prothorax and often faint or obscure.

Propodeal groove deep anteriorly, often disappearing posteriorly, being obscured by rugae; floor of groove often smooth anteriorily; propodeum usually rugose but occasionally granulose.

Petiole granulose, about same length as hind coxae.

Legs: Hind and middle femora black except at knees, sometimes only in basal half of middle femora; front femora dusky to black on dorsal face and remaining parts reddish-brown; hind and middle tibiae brownish to black; front tibiae reddish-brown.

Antennae: Flagellum with pedicel about the same length as head and thorax combined; first segment of flagellum not so wide as distal end of scape, as seen in lateral profile. Scape distinctly broadest in distal half, where there is a distinct shoulder; one-third as broad as long, exclusive of base.

Type-locality.—Minot, North Dakota.

Type.—Cat. No. 21769, U.S.N.M.

Described from many females and males reared from stems of species of *Elymus*, collected in Minot, North Dakota, by Mr. C. N. Ainslie, and from points in Nebraska collected by Mr. George I. Reeves. It forms galls in the stems of species of *Elymus* and has not been reared from any other grass. Males normally occur.

HARMOLITA OCCIDENTALIS, new species.

Plate 41, fig. 8; plate 44, fig. 8; plate 45, fig. 2; plate 46, fig. 1.

Female.—Length 2.5 mm. Praescutum regulose. Pronotal spots large, occupying about two-thirds anterior dorsal margin of prothorax.

Propodeum with a continuous, narrow, deep, margined, median, longitudinal groove; propodeum usually granulose, occasionally rugose, and either convex or flat laterad of groove.

Abdomen longer than head and thorax combined; second abdominal segment one-fifth the length of the abdomen; segment 3 shortest, 5 longest; 4, 6, and 7 subequal; abdomen as seen dorsally as broad in the sixth segment as in the third; sides of abdomen nearly parallel to the sixth segment.

Legs: Basal half of front femora, middle and hind legs fuscous; front tibiae testaceous to dusky, knee testaceous.

Antennae: First funicle plus ring-joint equal to pedicel; none of funicle or club joints quadrate; club slightly broader than the three preceding joints. Scape black.

Species small in size.

Male (pl. 46, fig. 1).—Length 1.9 mm. Praescutum as in female. Pronotal spots distinctly visible from above, occupying one-third of anterior dorsal margin of prothorax.

Propodeum with a distinct shallow, narrow groove; granulose, rarely rugose, laterad of groove.

Petiole about three-fourths of the length of hind coxae, granulose.

Legs: Basal half of front, middle and hind femora fuscous to black; middle and hind tibiae fuscous; front tibiae and knees testaceous to dusky.

Antennae: Flagellum with pedicel about same length as head and thorax combined; scape as seen in lateral profile broadening distally with a sloping shoulder; scape one-third as broad as long in widest place, exclusive of base; much broader than first flagellar joint.

Type-locality.—Koehler, New Mexico.

Type.—Cat. No. 21770, U.S.N.M.

Described from many females and males reared from stems of species of *Agropyron* collected in New Mexico by Mr. V. L. Wildermuth and in Kansas by Mr. E. O. G. Kelly. It makes inconspicuous galls near the head of species of *Agropyron* and has not been reared from any other grass. Males normally occur.

HARMOLITA GILLETTEI, new species.

Plate 41, fig. 6; plate 44, fig. 11; plate 45, fig. 3.

Female.—Length 2.5 mm. Praescutum rugulose. Pronotal spots large, well defined, occupying about two-thirds anterior dorsal margin of prothorax.

Propodeum with a continuous, median, narrow, deep, longitudinal groove which is margined throughout and deeper anteriorly; floor of groove usually more or less smooth in anterior half and with cross rugae in posterior half; propodeum rugose laterad of groove and granulose between the rugae.

Abdomen longer than head and thorax combined; segments 3 and 7 about equal in length and each shorter than 4, 5, or 6; 4 and 6 equal in length.

Legs: Basal one-half to two-thirds of front femora dusky to almost black; middle and hind femora brownish-black to black; distal portion of front femora, knees, and front tibiae luteous to testaceous; middle tibiae black and hind tibiae pale fuscous.

Antennae: First funicle plus ring-joint equal to or slightly longer than pedicel; none of funicle or club joints quadrate; club about same width as three preceding joints. Scape black.

Species medium to large and rather robust.

Males.—Unknown.

Type-locality.—Glenwood Springs, Colorado.

Type.—Cat. No. 21771, U.S.N.M.

Described from seven females in the United States National Museum. They were collected near Glenwood Springs, Colorado, by Mr. C. P. Gillette. Host plant unknown.

As previously stated in this paper, the writers have, by restricting the genus *Harmolita*, excluded the following species: *hageni* Howard, *bromi* Howard, *californicum* Howard, *abnorme* Ashmead, *montanum* Ashmead, and *nevadense* Ashmead. They have also dropped *Decatoma basilaris* Provancher from the synonomy as the types apparently cease to exist, Provancher himself in 1888[1] having thrown the species into synonomy under *hordei* Harris. Howard gave it as a synonym of *tritici* Fitch in 1896.[2]

EXPLANATION OF PLATES.

PLATE 39.

FIG. 1=ovipositor of *H. atlantica.*
2=ovipositor of *H. websteri.*
3=ovipositor of *H. elymi.*
4=ovipositor of *H. grandis* form *grandis.*
5=ovipositor of *H. grandis* form *minuta.*
6=ovipositor of *H. elymoxena.*
7=ovipositor of *H. agropyrophila.*
8=ovipositor of *H. maculata.*
9=ovipositor of *H. captiva.*
10=ovipositor of *H. poae.*

PLATE 40.

FIG. 1=ovipositor of *H. rufipes.*
2=ovipositor of *H. elymivora.*
3=ovipositor of *H. ovata.*
4=ovipositor of *H. hesperus.*
5=ovipositor of *H. elymophthora.*
6=ovipositor of *H. bromicola.*
7=ovipositor of *H. dactylicola.*
8=ovipositor of *H. albomaculata.*
9=front and profile view of the ovipositor of *H. elymicola.*

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[1] Prov. Addit faun. Can. Hym., p. 438, 1888.

[2] U. S. Dept. Agr., Div. Ent., Bull. tech. ser. No. 2, p. 18, 1896.

PLATE 41.

FIG. 1=ovipositor of *H. elymophila.*
2=ovipositor of *H. agropyrocola.*
3=ovipositor of *H. vaginicola.*
4=ovipositor of *H. tritici.*
5=ovipositor of *H. hordei.*
6=ovipostor of *H. gilletti.*
7=ovipositor of *H. secalis.*
8=ovipositor of *H. occidentalis.*
9=ovipositor of *H. poophila.*
10=ovipositor of *H. festucae.*

All illustrations in plates 39, 40, and 41 are drawn to the same scale and greatly enlarged.

PLATE 42.

FIG 1=*H. tritici;* illustrating the sculpturing of the praescutum of the gall-forming species.
FIG. 2=*M. maculata;* illustrating the sculpturing of the praescutum of the species that occupy the center of the stem in various plants.

Illustrations greatly enlarged.

PLATE 43.

FIG. 1=propodium of the female of *H. agrostidis.*
2=propodium of the female of *H. websteri.*
3=propodium of the female of *H. albomaculata.*
4=propodium of the female of *H. albomaculata.*
5=propodium of the female of *H. captiva.*
6=propodium of the female of *H. poae.*
7=propodium of the female of *H. dactylicola.*
8=propodium of the female of *H. elymi.*
9=propodium of the female of *H. bromicola.*
10=propodium of the female of *H. maculata.*
11=propodium of the female of *H. agropyrophila.*
12=propodium of the female of *H. secalis.*
13=propodium of the female of *H. vaginicola.*
14=propodium of the female of *H. festucae.*
15=propodium of the female of *H. atlantica.*

PLATE 44.

FIG. 1=propodium of the female of *H. tritici.*
2=propodium of the female of *H. rufipes.*
3=propodium of the female of *H. elymivora.*
4=propodium of the female of *H. elymophila.*
5=propodium of the female of *H. hesperus.*
6=propodium of the female of *H. hordei.*
7=propodium of the female of *H. ovata.*
8=propodium of the female of *H. occidentalis.*
9=propodium of the female of *H. agropyrocola.*
10=propodium of the female of *H. elymicola.*
11=propodium of the female of *H. gilletti.*
12=propodium of the female of *H. elymoxena.*
13=propodium of the female of *H. poophila.*
14=propodium of the female of *H. elymophthora.*

All illustrations in plates 43 and 44 are drawn to the same scale and greatly enlarged.

PLATE 45.

FIG. 1=antenna of the female of *H. elymoxena*.
2=antenna of the female of *H. occidentalis*.
3=antenna of the female of *H. gillettei*.
4=antenna of the female of *H. elymicola*.
5=antenna of the female of *H. ovata*.
6=antenna of the female of *H. bromicola*.
7=antenna of the female of *H. agrostidis*.
8=antenna of the female of *H. elymophila*.
9=antenna of the female of *H. agropyrocola*.
10=antenna of the female of *H. festucae*.
11=antenna of the female of *H. captiva*.
12=antenna of the female of *H. tritici*.
13=antenna of the female of *H. elymivora*.
14=antenna of the female of *H. maculata*.
15=antenna of the female of *H. grandis* form *minuta*.
16=antenna of the female of *H. dactylicola*.
17=antenna of the female of *H. albomaculata*.
18=antenna of the female of *H. poae*.
19=antenna of the female of *H. agropyrophila*.
20=antenna of the female of *H. grandis* form *grandis*.
21=antenna of the female of *H. elymi*.

PLATE 46.

FIG. 1=antenna of the male of *H. occidentalis*.
2=antenna of the male of *H. atlantica*.
3=antenna of the male of *H. elymoxena*.
4=antenna of the female of *H. atlantica*.
5=antenna of the male of *H secalis*.
6=antenna of the female of *H. poophila*.
7=antenna of the male of *H. rufipes*.
8=antenna of the female of *H. hordei*.
9=antenna of the female of *H. websteri*.
10=antenna of the female of *H. elymophthora*.
11=antenna of the female of *H. rufipes*.
12=antenna of the male of *H. festucae*.
13=antenna of the female of *H vaginicola*.
14=antenna of the female of *H. secalis*.
15=antenna of the female of *H. hesperus*.

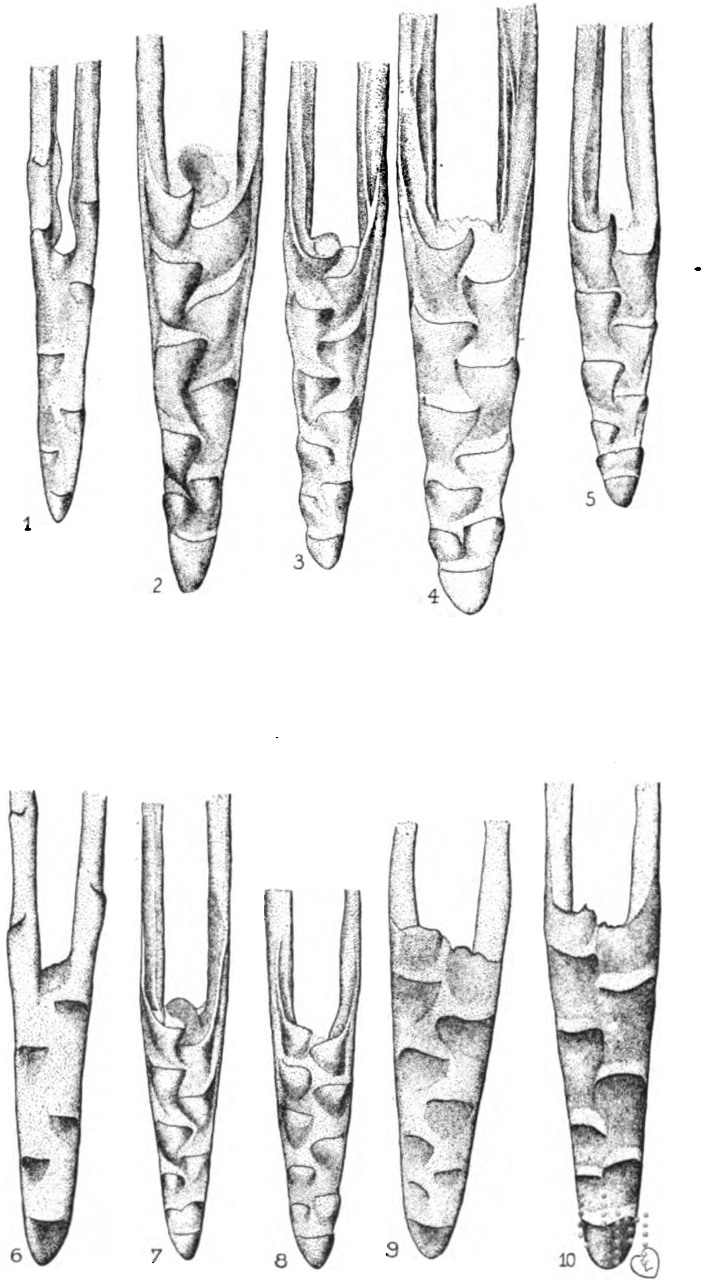
PLATE 47.

FIG. 1=antenna of the male of *H. poae.*
2=antenna of the male of *H. elymophthora.*
3=antenna of the male of *H. hesperus.*
4=antenna of the male of *H. tritici.*
5=antenna of the male of *H. poophila.*
6=antenna of the male of *H. captiva.*
7=antenna of the male of *H. maculata.*
8=antenna of the male of *H. agropyrophila.*
9=antenna of the male of *H. elymivora.*
10=antenna of the male of *H. elymophila.*

PLATE 48.

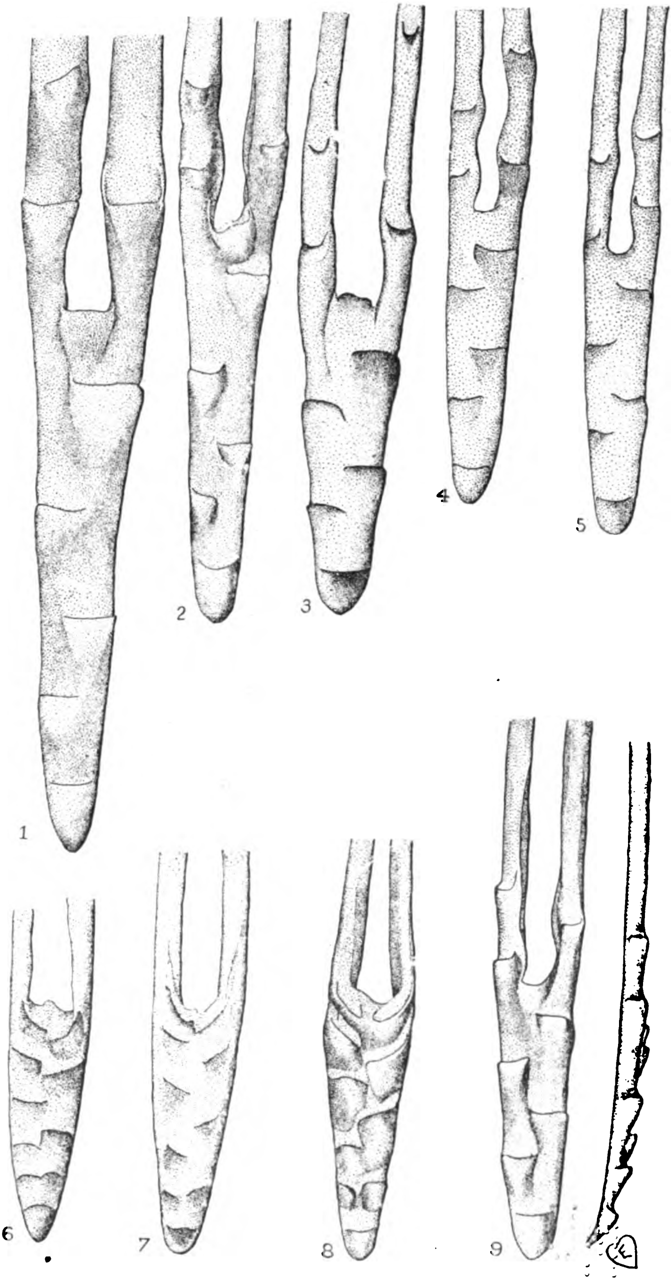
FIG. 1=antenna of the male of *H. grandis* form *minuta.*
2=antenna of the male of *H. elymicola.*
3=antenna of the male of *H ovata.*
4=antenna of the male of *H. dactylicola.*
5=antenna of the male of *H. albomaculata.*
6=antenna of the male of *H. websteri.*
7=antenna of the male of *H. hordei.*

All illustrations in plates 45, 46, 47, and 48 are drawn to the same scale and greatly enlarged.



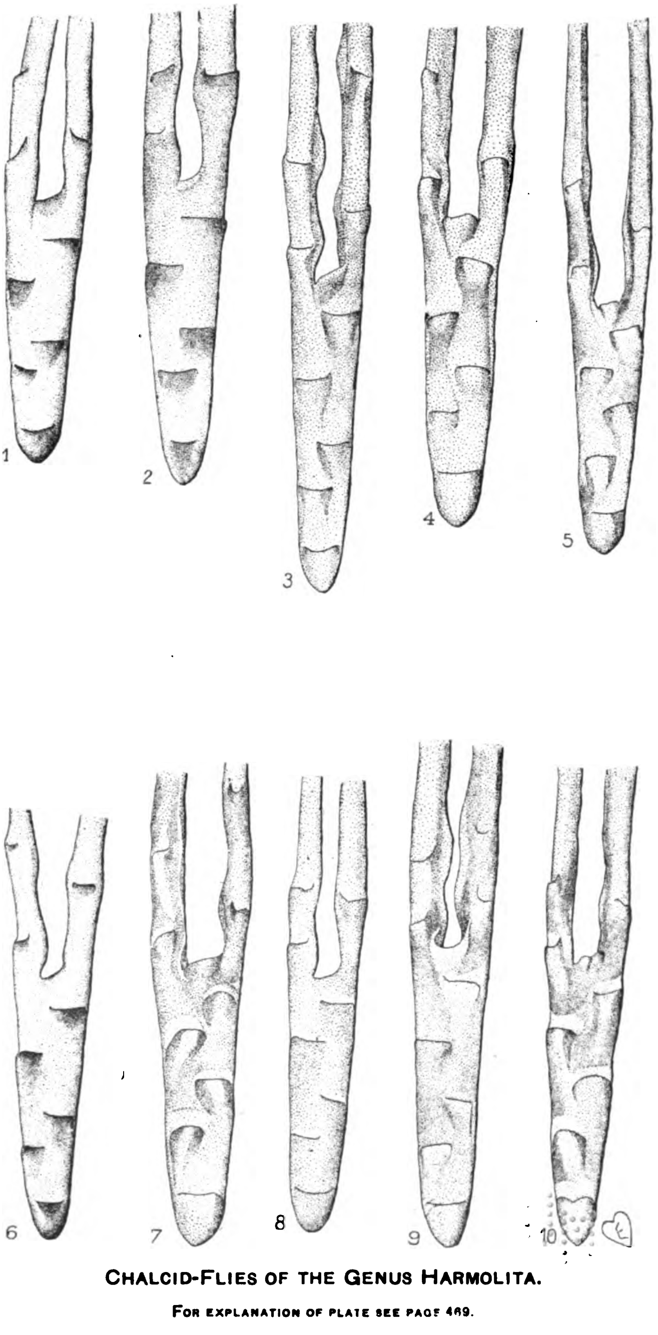
CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 468.



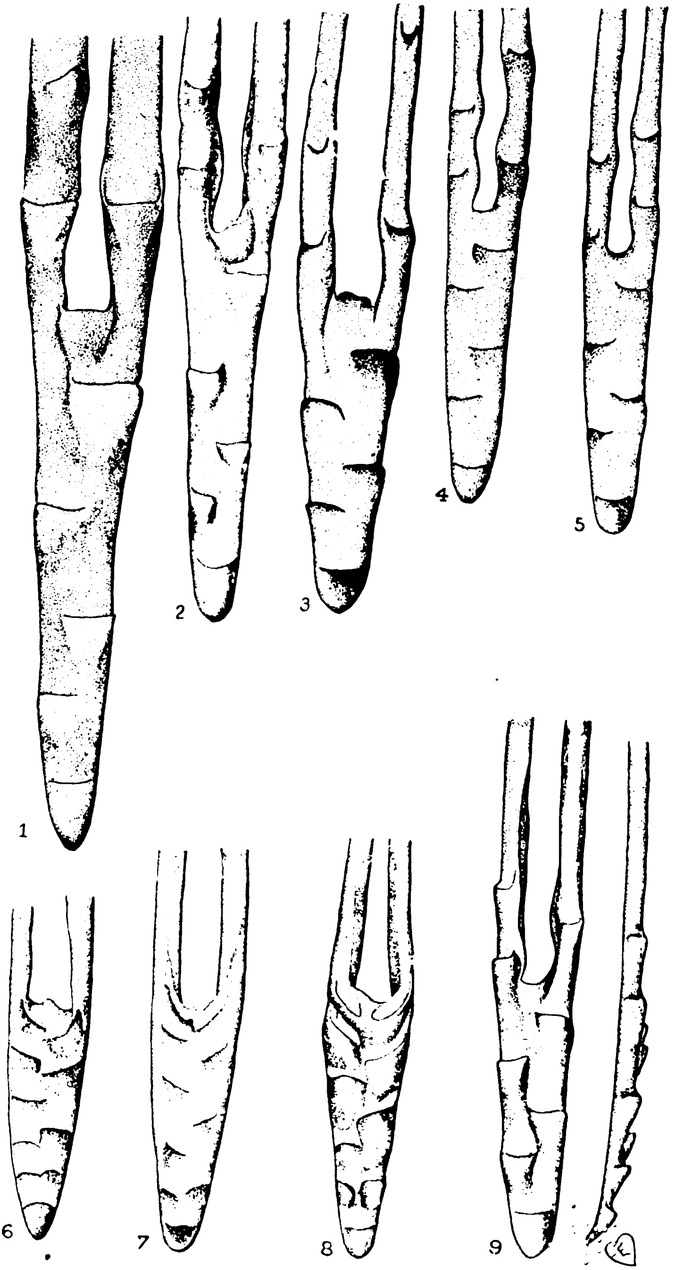
Chalcid-Flies of the Genus Harmolita.

For explanation of plate see page 468.



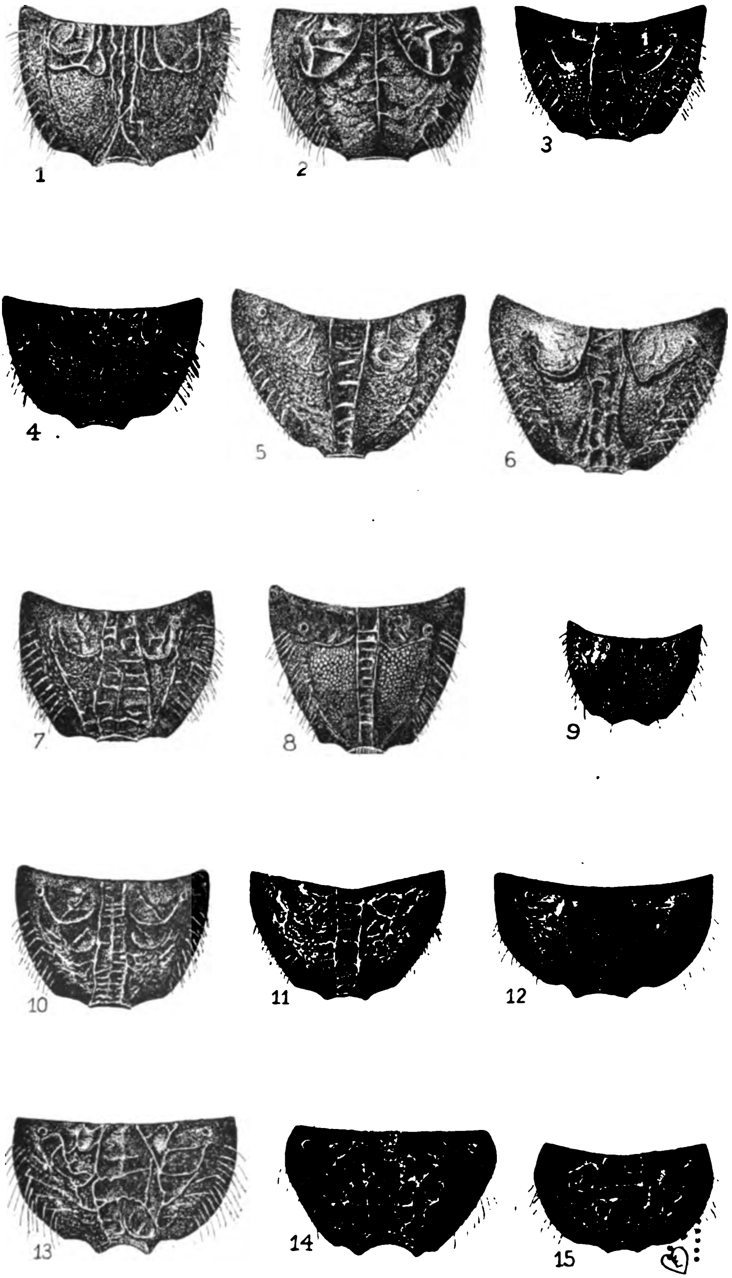
CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 469.



CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 468.



CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 469

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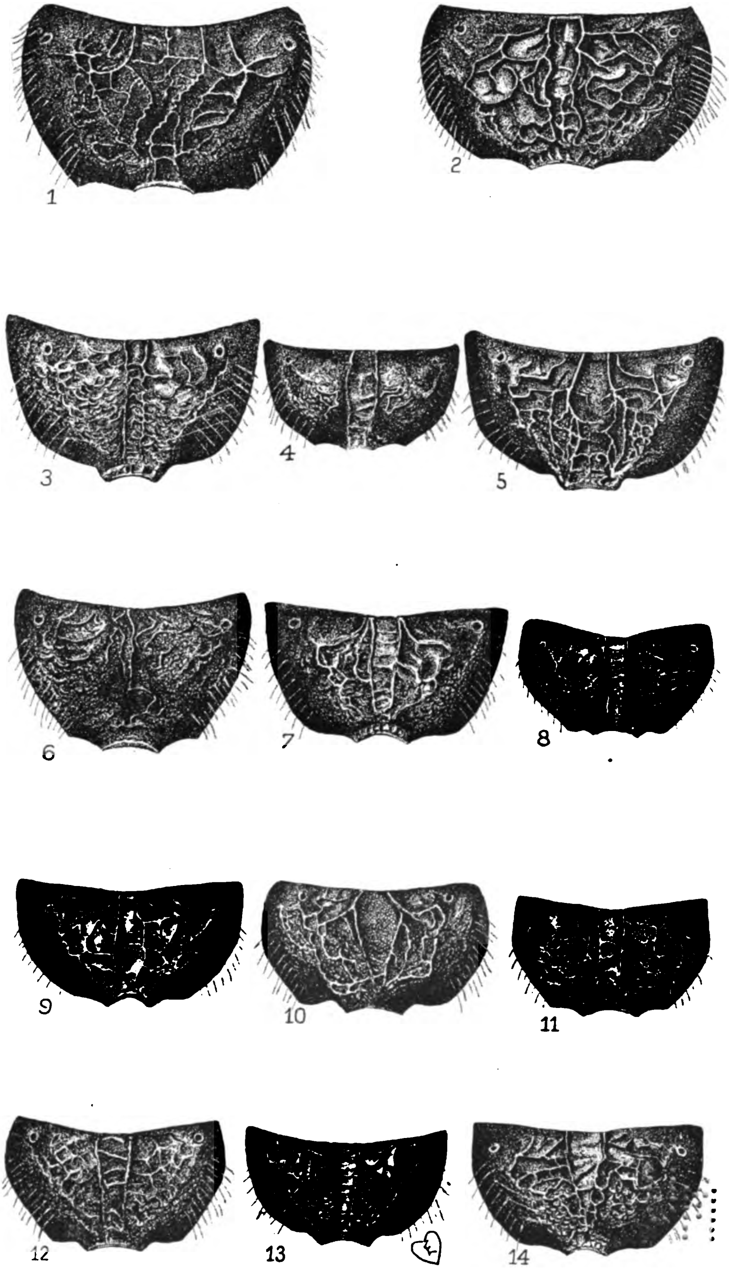

CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 469.

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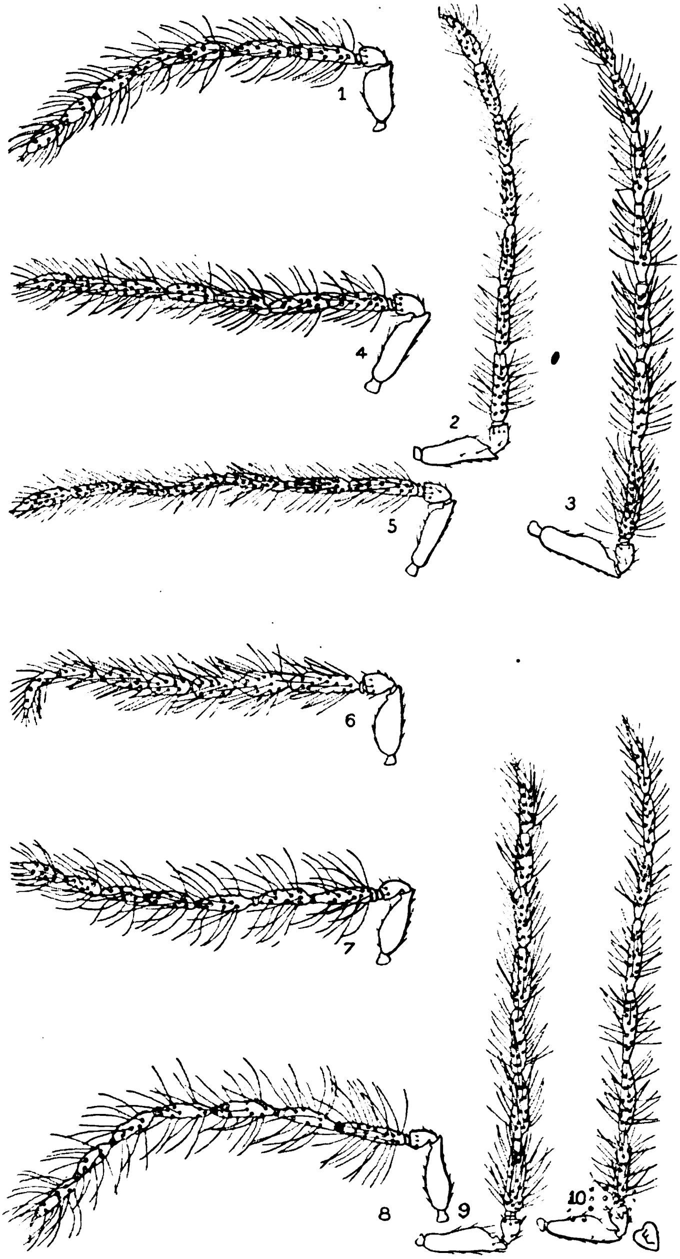
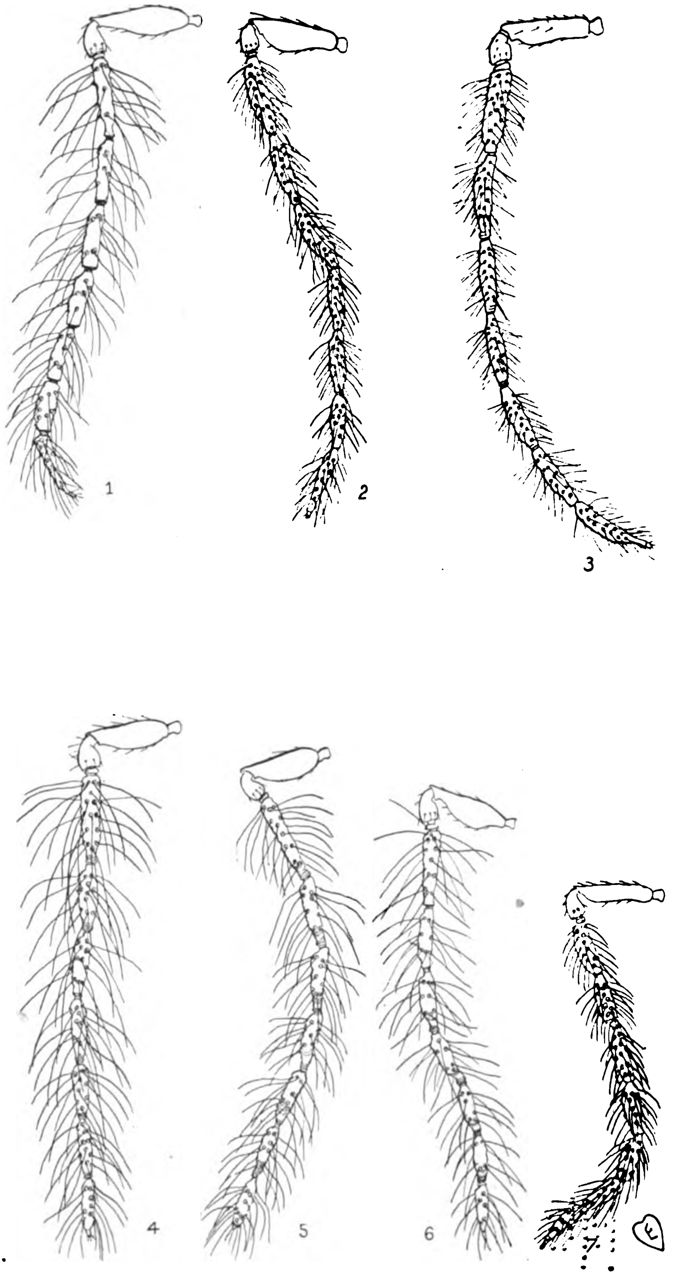


CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 471.



CHALCID-FLIES OF THE GENUS HARMOLITA.

FOR EXPLANATION OF PLATE SEE PAGE 471

NOTES ON DR. W. L. ABBOTT'S SECOND COLLECTION OF BIRDS FROM SIMALUR ISLAND, WESTERN SUMATRA.

By Harry C. Oberholser,
Of the Biological Survey, United States Department of Agriculture.

Dr. W. L. Abbott's first collection of birds from Simalur Island was made during the latter part of the year 1901. This island, which is about 55 miles long and well forested, lies somewhat less than a hundred miles off the western coast of Sumatra, and about 200 miles from the northwestern end. It is one of the Barussan Islands, which extend along the western coast of Sumatra; and the accompanying map[1] shows its relative position. The birds obtained by Doctor Abbott on his first visit have already been listed by Dr. C. W. Richmond, and a number of novelties described.[2]

On his second trip Doctor Abbott remained about a week, from October 21 to October 26, 1902, most of this time at Sibabo Bay. The ornithological results consisted of 70 specimens of birds, representing 38 species. All the new forms, with one exception,[3] have already been described.[4] Two species, *Macropygia emiliana hypopercna* Oberholser, and *Treron curvirostra haliploa* Oberholser, are actual additions to the avifauna of this island, and these, together with those already recorded by Doctor Richmond,[5] make a total of 79 species of birds now known to occur on Simalur Island itself, not counting the neighboring islets of Pulo Asu and Pulo Siumat.

All measurements in this list have been taken in millimeters, after the manner described in the writer's paper on *Butorides virescens.*[6] In a number of cases, particularly those of recently named subspecies, the measurements given have not been confined to specimens in the present collection, but, for the sake of completeness, have been extended to all the adult Simalur Island birds in the United States National Museum. The names of colors are from Mr. Ridgway's Color Standards and Color Nomenclature.

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[1] See p. 475.
[2] Proc. U. S. Nat. Mus., vol. 26, Feb. 4, 1903, pp. 485–524.
[3] See p. 476.
[4] Oberholser, Smiths. Misc. Coll., vol. 26, No. 7, October 26, 1912, pp. 1–22.
[5] Proc. U. S. Nat. Mus., vol. 26, Feb. 4, 1903, pp. 485–521.
[6] Idem, vol. 42, 1912, p. 533.

Family ARDEIDAE.

TYPHON SUMATRANUS (Raffles).

Ardea sumatrana RAFFLES, Trans. Linn. Soc. Lond., ser. 1, vol. 13, pt. 2, 1822, p. 325 (Sumatra).

One specimen, an adult female, from Sibabo Bay, collected, October 23, 1902. Length in flesh,[1] 1155 mm.

Family ACCIPITRIDAE.

SPILORNIS ABBOTTI Richmond.

Spilornis abbotti RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4 1903, p. 492 (Simalur Island, western Sumatra).

Two specimens are in the present collection:

Adult male, No. 179620, U.S.N.M.; Sibabo Bay, October 24, 1902. Length in flesh, 520 mm. "Iris deep yellow; bill leaden, base of bill yellow; inside of mouth leaden; cere and lores deep yellow; feet dirty orange yellow; claws black."

Adult, No. 179621, U.S.N.M.; Sibabo Bay, October 26, 1902. Length in flesh, 521 mm. "Iris golden yellow; bill leaden; cere and naked skin on head, bright yellow; feet dirty orange yellow; claws black."

These two examples are in full plumage and agree with the type series. This interesting hawk appears to be a perfectly distinct species, there being no evidence, individual or geographical, of its intergradation with any form of the Sumatran *Spilornis bassus*.

ASTUR SOLOENSIS (Horsfield).

Falco Soloënsis HORSFIELD, Trans. Linn. Soc. Lond., ser. 1, vol. 13, pt. 1, May, 1821, p. 137 (Java).

One female in juvenal plumage, No. 179629, U.S.N.M.; taken at Sibabo Bay, October 24, 1902. Length in flesh, 287 mm. "Iris yellow; feet yellow; claws black.

Family RALLIDAE.

AMAURORNIS PHOENICURA CLEPTEA Oberholser.

Amaurornis phoenicura cleptea OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 2 (Mojela River, Nias Island, western Sumatra).

One specimen is in the collection, an adult male, No. 179538, U.S.N.M.; taken, October 26, 1902. This example agrees with the three other males previously obtained by Doctor Abbott on Simalur Island;[2] and all four are, so far as we can see, indistinguishable from the type series of *Amaurornis phoenicura cleptea* Oberholser, from the island of Nias.[3] This has been tentatively synonymized with

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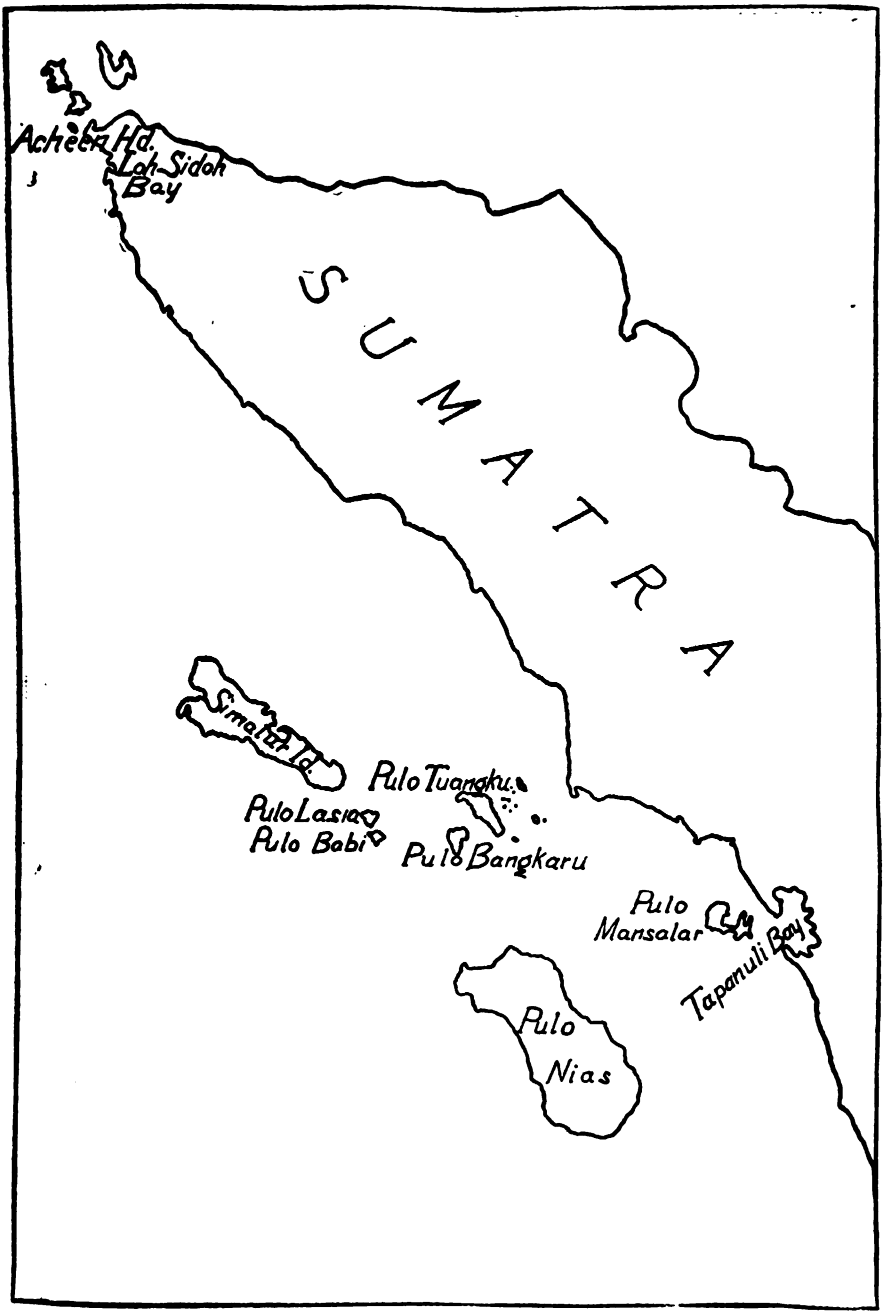
[1] Measured by the collector.

[2] See Richmond, Proc. U. S. Nat. Mus., vol. 26, 1903, p. 488.

[3] Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 2.



NORTHWESTERN SUMATRA AND ADJACENT ISLANDS.

Amaurornis phoenicura javanica (Horsfield) by Mr. Erwin Stresemann;[1] but it is a recognizable race, differing from *Amaurornis phoenicura javanica* in its decidedly darker upper parts, particularly the pileum. It is apparently confined to the Barussan Islands.

Measurements of all our Simalur Island birds, together with the type series of *Amaurornis phoenicura cleptea* from Nias Island, are given below.

Measurements of specimens of Amaurornis phoenicura cleptea.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
				mm.	*mm.*	*mm*	*mm.*	*mm.*	*mm.*
179538	Male...	Simalur Island, western Sumatra	Oct. 26, 1902	....	149	59.5	36.5	57	55
179011	...do....	.....do............	Dec. 9, 1901	....	147	57.5	....	57	54.5
179010	...do....	.....do............	Dec. 10, 1901	....	157	62	39	55	54
179012	...do....	.....do............	Dec. 16, 1901	....	164	62	39	56.5	53
180786	Female.	Nias Island, western Sumatra.[b]	Mar. 11, 1905	300	135	48	35	52	52
179536	...do....	.....do............	Mar. 29, 1903	295	134	54	34	52	52
179537	...do....	.....do............	Mar. 30, 1903	320	160	70	34	51.5	49.5

[a] Measured in the flesh by the collector. [b] Type.

HYPOTAENIDIA STRIATA RELIQUA, new subspecies.

Subspecific characters.—Similar to *Hypotaenidia striata gularis*, from Java, but upper parts, including upper surface of wings, darker, the middle of pileum with more blackish, the portions posterior to cervix with ground color more olivaceous (less grayish), and with black and white areas both more extensive; lower parts darker, the middle of abdomen and the crissum more barred or otherwise marked with blackish.

Description.—Type,[2] adult female, No. 179013, U.S.N.M.; Simalur Island, Barussan Islands, western Sumatra, December 12, 1901; Dr. W. L. Abbott. Pileum and cervix, chestnut, laterally becoming lighter, inclining toward tawny, medially streaked with dull black; ground color of remaining upper parts olive brown, verging anteriorly toward brownish olive, and becoming bister on the upper tail-coverts, most of the feathers brownish black medially and having one or more conspicuous white bars; tail blackish clove brown, with narrow bars of dull chamois and honey yellow; primaries and secondaries between clove brown and bister, with narrow more or less imperfect bars of dull chamois, dull cream buff, and whitish; tertials blackish clove brown, with irregular and sometimes interrupted bars of dull chamois, cream buff, and buffy white; superior wing-coverts olive brown, barred with creamy or buffy white and brownish black; chin and upper throat creamy white; lores, cheeks, auriculars, lower portion of sides of neck, together with lower throat and breast, neutral gray, with in places a wash of olivaceous; posterior lower parts hair brown medially, shading to chaetura drab laterally and on crissum, everywhere conspicuously barred with white or creamy white, these bars widest and farthest apart on sides and flanks, and inclined to merge on middle of lower breast and abdomen, so that these parts present a noticeably whitish appearance; lining of wing between hair brown and chaetura drab, conspicuously barred with white; "iris pale yellow brown; bill dark brown, red beneath and at base."

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[1] Novit. Zool., vol. 20, June, 1913, pp. 303–304.

[2] From Doctor Abbott's first collection on Simalur Island.

Of this new race there is but a single specimen in the present collection, an adult female, No. 179539, U.S.N.M., taken at Sibabo Bay on October 26, 1902. The colors of the soft parts in this example are given by the collector as follows: "Iris red; bill pinkish red, tip horn brown; feet dull brownish purple." It agrees essentially in color with the type, the only observable difference of note being its rather lighter lower surface, posteriorly somewhat less heavily dark-marked.

This new race is apparently confined to the Barussan Islands. It differs from *Hypotaenidia striata albiventris* (Swainson),[1] from India and the Malay Peninsula, in having its median posterior lower parts darker, more heavily barred with blackish (less uniformly whitish or buffy); more white on back and scapulars; and usually more black on center of pileum. There is in this species, as, of course, is well known, much individual variation in the size and number of the white markings on the upper surface, so that this character is perhaps of least value in the diagnosis above given. Measurements of the Simalur Island specimens are given herewith:

Measurements of specimens of Hypotaenidia striata reliqua.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179013	Female.	Simalur Island, western Sumatra[b]	Dec. 12, 1901	241	110	39	31	32	34
179539	...do...	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 26, 1902	....	106.5	41	30	34.5	32

[a] Measured in the flesh by the collector. [b] Type.

The following subspecies of *Hypotaenidia striata* seem now to be recognizable:

Hypotaenidia striata striata (Linnaeus).—Philippine Islands, Celebes, Borneo, and (?) Sumatra.

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[1] *Rallus albiventer* Swainson, Anim. in Menag., 1837, p. 337 (India).

Hypotaenidia striata reliqua Oberholser.—Barussan Islands.

Hypotaenidia striata gularis (Horsfield).—Java.

Hypotaenidia striata obscurior Hume.—Andaman Islands.

Hypotaenidia striata albiventris (Swainson).—India to the Malay Peninsula and Cochin China.

Hypotaenidia striata jouyi (Stejneger).—Southern China.

Family COLUMBIDAE.

MACROPYGIA EMILIANA HYPOPERCNA Oberholser.

Macropygia emiliana hypopercna OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 2 (Sibabo Bay, Simalur Island, western Sumatra).

One specimen, the type, a juvenal, nearly adult, sex unknown, No. 179599, U.S.N.M., taken, October 26, 1902. The color of the bill is given as "pale pinky brown."

This race, which appears to be peculiar to Simalur Island, differs from *Macropygia emiliana elassa*,[1] of North Pagi Island, in its darker rump; more richly colored, usually darker, lower surface; darker chin, which is thus but little if any different from the color of the cheeks, not pale buffy as in *Macropygia emiliana elassa;* and in the more brightly colored under surface of tail, the tips of the rectrices being much more richly rufescent.

It is not, however, as incorrectly stated in the original description,[2] larger than *Macropygia emiliana elassa*, but of practically the same size.

From *Macropygia emiliana modiglianii* Salvadori, of Nias Island, the present subspecies differs in its smaller size, darker rump and lower parts, and particularly darker and more uniform, not distinctly buffy, chin. Compared with *Macropygia emiliana emiliana* from Java, it is somewhat larger; decidedly lighter, more brightly rufous above, especially on the wings; more richly or brightly rufescent on the lower surface, with rufous of under surface of tail lighter, and with chin darker, not conspicuously buffy or whitish in contrast to the throat and cheeks.

The measurements of the type of *Macropygia emiliana hypopercna* are: wing, 171.5 mm.; tail, 180; exposed culmen, 18; tarsus, 25; middle toe without claw, 24.5.

MACROPYGIA RUFICEPS SIMALURENSIS Richmond.

Macropygia simalurensis RICHMOND, Proc. Biol. Soc. Wash., vol. 15, August 6, 1902, p. 187 (Simalur Island, western Sumatra).

One adult male, No. 179600, U.S.N.M.; Sibabo Bay, October 22, 1902. Length in flesh, 327 mm. "Iris blue; feet dark red; bill and cere dark brown."

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[1] Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 2.

[2] Idem.

This bird agrees with the original specimens and shows *Macropygia simalurensis* Richmond to be easily recognizable as distinct from *Macropygia ruficeps* of Java. It is, however, only a subspecies of that bird. It differs from *Macopygia ruficeps ruficeps*, which we now have for comparison, in its darker pileum, more extensively rufous chestnut upper wing-coverts, and darker lower parts, particularly the chin, which is scarcely paler than the more posterior areas, instead of tawny buff or even whitish in *Macropygia ruficeps ruficeps*. The present specimen shows some indications of molt among the contour feathers.

Family TRERONIDAE.

MUSCADIVORES AENEUS MISTUS Oberholser.

Muscadivores aeneus mistus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 2 (Simalur Island, western Sumatra).

One adult female, No. 179550, U.S.N.M.; from Sibabo Bay, October 24, 1902. Length in flesh, 397 mm. "Bill leaden, cere dull purple; feet dark purple."

This example is in fresh plumage, but still shows a little evidence of molt among the outer primaries. It fully agrees with the type and others of the type series of this subspecies.

The characters that separate *Muscadivores aeneus mistus* from *Muscadivores aeneus consobrina* of Nias Island, which is clearly a subspecies of *Muscadivores aeneus*, are the shorter wing and somewhat shorter tail of the former, combined with its distinctly more pinkish vinaceous (less grayish) posterior lower parts; usually somewhat paler anterior lower surface; and, on the average, less reddish bronzy sheen of the green posterior upper parts, though in the last there is considerable individual variation. From *Muscadivores aeneus aeneus*, of Borneo, the present race may readily be distinguished by its smaller size; much more grayish (less vinaceous) head and lower parts; less whitish chin and forehead; and darker lower tail-coverts.

Measurements of our entire series from Simalur Island are for comparison given in the subjoined table.

Measurements of specimens of Muscadivores aeneus mistus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Wing.	Tail.	Exposed culmen.	Tarsus.
179044	Male	Simalur Island, western Sumatra..	Nov. 24, 1901	222.5	131	23.5	29.5
179049	do.	.....do..............................	Nov. 27, 1901	220	131.5	22	32
179050	do.	.....do..............................	Dec. 1, 1901	231.5	134	22	29.5
179053	do.	.....do..............................	Dec. 4, 1901	225	127.5	24	31
179051	do.	.....do..............................	Dec. 15, 1901	229	134	21.5	28.5
179054	do.	.....do[a]............................	Jan. 2, 1902	226.5	135	22	31.5
179550	Female.	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 24, 1902	221	129	22	30.5
179045	do.	Simalur Island, western Sumatra..	Nov. 25, 1901	208	119	22.5	29.5
179047	do.	.....do..............................	...do.........	217	126	23	28.5
179046	do.	.....do..............................	...do.........	217	120.5	20.5	30
179048	do.	.....do..............................	Nov 27, 1901	222	125.5	22.5	29.5

[a] Type.

DENDROPHASSA VERNANS MIZA Oberholser.

Dendrophassa vernans miza OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 3 (Simalur Island, western Sumatra).

One adult male, No. 179591, U.S.N.M., from Sibabo Bay, October 23, 1902.

This example agrees with others from Simalur Island, which, together with it, formed the basis of the present subspecies. This race may readily be distinguished from *Dendrophassa*[1] *vernans vernans* of the Malay Peninsula and Sumatra by its decidedly larger size and, in the male, darker under parts and less yellowish (more grayish green) lower breast. Compared with *Dendrophassa vernans mesochloa* of Nias Island it is decidedly larger; the male is darker both above and below, and has the olive green of the posterior lower parts less yellowish; the female is darker, somewhat less yellowish above, darker on the lower tail-coverts, and darker, less yellowish (more grayish) on the remaining lower surface.

Measurements of all our Simalur Island specimens are added below.

Measurements of specimens of Dendrophassa vernans miza.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.
179034	Male...	Simalur Island, western Sumatra.	Nov. 22, 1901	296	156	99.5	16.5	24
179036	...do....	.....do......................	Nov. 26, 1901	298.5	156	100.5	17	24
179591	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 23, 1902	....	156	104.5	16.5	24
179035	Female.	Simalur Island, western Sumatra.[b]	Nov. 22, 1901	279.5	152	97	15	23.5

[a] Measured in the flesh by the collector. [b] Type.

TRERON CURVIROSTRA HALIPLOA Oberholser.

Treron curvirostra haliploa OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 4 (Sibabo Bay, Simalur Island, western Sumatra).

One specimen, the type, an adult male, No. 179592, U.S.N.M., Sibabo Bay, October 22, 1902. Length in flesh, 290 mm. "Iris orange; naked orbital skin yellow green; bill pale yellow, base deep red; feet dull purple."

This subspecies is readily distinguishable from *Treron curvirostra*[2] *harterti* of Sumatra by its decidedly larger size, paler pileum, nape, rump, and upper tail-coverts, and somewhat lighter under surface, particularly the chin and upper throat, which are also more clearly yellowish (less tinged with grayish). From *Treron curvirostra pega* Oberholser,[1] of Nias Island, it is separable by somewhat larger size; lighter pileum, nape, and rump; paler, more yellowish upper tail-coverts; lighter, much more yellowish (less grayish) lower surface.

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[1] For the change of generic name from *Osmotreron* Bonaparte to *Dendrophassa* Gloger, see Oberholser, Smiths. Misc. Coll., vol. 60, N. 7, October 26, 1912, p. 2.

[2] For the change of the specific name of this species from *Treron nipalensis* to *Treron curvirostra* (Gmelin) see Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 3.

Measurements of this, the type specimen, are as follows: wing, 145 mm.; tail, 94; exposed culmen, 16.5; tarsus, 24.5; middle toe without claw, 24.

Family PSITTACIDAE.

CONURUS FASCIATUS CALUS Oberholser.

Conurus fasciatus calus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 4 (Sibabo Bay, Simalur Island, western Sumatra).

Four specimens are in the collection:

Adult male, type of the subspecies, No. 179664, U.S.N.M.; Sibabo Bay, October 21, 1902.

Adult male, No. 179666, U.S.N.M.; Sibabo Bay, October 25, 1902. "Upper mandible red, tip yellow; lower mandible dark brown; feet dull greenish leaden."

Adult female, No. 179665, U.S.N.M.; Sibabo Bay, October 22, 1902. "Bill black."

Adult female, No. 179667, U.S.N.M.; Sibabo Bay, October 26, 1902.

This recently described race differs from *Conurus*[2] *fasciatus fasciatus*, of Tenasserim, in its much larger size; darker and duller upper parts; darker, duller, rather more bluish posterior lower parts; and, in the male, paler anterior lower parts; in the female. duller and usually lighter anterior lower surface. From *Conurus fasciatus perioncus*,[1] of Nias Island, it may be distinguished by its somewhat smaller size; darker upper parts, especially the pileum; darker, more bluish posterior lower surface; and darker, duller throat and breast.

The females differ from the males in having a wholly black or brownish black bill (lacking the red maxilla or having at most but a tinge of reddish on the base of the culmen); somewhat darker and duller upper parts; and lighter, more pinkish, less lavender-washed breast and jugulum. The moderate amount of individual variation affects principally the shade of the pileum, breast, jugulum, and posterior lower surface.

Measurements of our entire series from Simalur Island are added here for purposes of comparison.

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[1] Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 4.

[2] For the change of generic name from *Palaeornis* to *Conurus*, see Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, Oct. 26, 1912, p. 4.

Measurements of specimens of Conurus fasciatus calus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen with cere.	Tarsus.	Middle toe without claw.
179121	Male...	Simalur Island, western Sumatra.	Nov. 24, 1901	375	169.5	187	27	18.5	20.5
179122	...do....	.....do............	Nov. 25, 1901	368.5	173	....	26.5	18	22.5
179124	...do....	.....do............	Nov. 27, 1901	393.5	173	191	27	17	21
179125	...do....	.....do............	.....do........	375	174	182	26	17.3	21
179666	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 25, 1902	392	172	197.5	28	17	21.5
179664	...do....	.....do.[b]...........	Oct. 21, 1902	402	180.5	201	28	18.5	22
179118	Female	Simalur Island, western Sumatra.	Nov. 19, 1901	355.5	170	176	26	17	21
179120	...do....	.....do............	Nov. 22, 1901	355.5	175.5	160	27	17	20.3
179119	...do....	.....do............	.....do........	368.5	171.5	173	26.5	17.5	21
179123	...do....	.....do............	Nov. 25, 1901	362	173	171	26	17.8	20.5
179126	...do....	.....do............	Dec. 2, 1901	349	167.5	160.5	26	16.5	20
179665	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 22, 1902	369	176	172	24	17	21
179667	...do....	.....do............	Oct. 26, 1902	364	170	182.5	26.5	17	20

[a] Measured in the flesh by the collector.

[b] Type.

PSITTINUS ABBOTTI Richmond.

Psittinus abbotti RICHMOND, Proc. Biol. Soc. Wash., vol. 15, August 6, 1902, p. 188 (Simalur Island, western Sumatra).

Four specimens:

Adult male, No. 179633, U.S.N.M.; Sibabo Bay, October 25, 1902. Total length in flesh, 205 mm. "Iris yellow; feet greenish."

Adult female, No. 179634, U.S.N.M.; Sibabo Bay, October 25, 1902. Total length in flesh, 210 mm. "Iris straw yellow; upper mandible horn brown; lower mandible pale brownish fleshy."

Adult female, No. 179635, U.S.N.M.; Sibabo Bay, October 25, 1902. Total length in flesh, 205 mm.

Juvenal male, No. 179632, U.S.N.M.; Sibabo Bay, October 22, 1902. Total length in flesh, 211 mm. "Upper mandible dull red; lower mandible pale horn brown."

These agree with the original specimens, and show that this is a remarkably distinct species, confined apparently to Simalur Island.

Family PICIDAE.

THRIPONAX JAVENSIS PARVUS Richmond.

Thriponax parvus RICHMOND, Proc. Biol. Soc. Wash., vol. 15, August 6, 1902, p. 189 (Simalur Island, western Sumatra).

Two specimens:

Adult male, No. 179687, U.S.N.M.; Sibabo Bay, October 21, 1902. Length in flesh, 360 mm.

Adult female, No. 179686, U.S.N.M.; Sibabo Bay, February 22, 1902. Length in flesh, 354 mm. "Iris greenish yellow; bill black; feet gray leaden."

Both of these are in process of molt of quills and contour feathers. They agree perfectly with the type series from the island of Simalur, and show *Thriponax javensis parvus* to be an excellent race, in fact, almost a distinct species, which it would be were there not a small form of *Thriponax javensis* in the Philippine Islands, *Thriponax javensis suluensis*, the individual variation of which bridges over the gap in characters. For this reason, however, it must stand as *Thriponax javensis parvus*.

Family MEROPIDAE.

MEROPS SUPERCILIOSUS JAVANICUS Horsfield.

Merops Javanicus HORSFIELD, Trans. Linn. Soc. Lond., ser. 1, vol. 13, pt. 1, May, 1821, p. 171 (Java).

One adult male, No. 179711, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 309 mm.

This is rather light-colored below, but otherwise not peculiar. It is in all essential respects identical with birds from the Malay Peninsula, which, together with those from Sumatra and Borneo, differ from Philippine specimens in being larger, less tinged with golden or coppery on the green portions of the upper parts, and more bluish, less golden or brownish, green below. These differences are easily seen on comparison, particularly of a series, and are well worthy of recognition by name. Birds from India are indistinguishable from those of the Malay Peninsula.

The original *Merops philippinus*[1] came from the Philippine Islands; and the earliest name applicable to the Malay form is, therefore, *Merops javanicus* Horsfield,[2] from Java.

The ranges of the two forms here considered are as follows:

Merops superciliosus philippinus LINNAEUS.—Philippine Islands to Celebes.

Merops superciliosus javanicus HORSFIELD.—India, Ceylon, Burmah, to Cochin China, southern China, Siam, Malay Peninsula, Sumatra, Borneo, Java, and Timor.

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[1] Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766, p. 183 (see errata at end of volume).

[2] Trans. Linn. Soc. Lond., ser. 1, vol. 13, pt. 1, May, 1821, p. 171 (Java).

Comparative measurements are given below:[1]

Measurements of specimens of Merops superciliosus philippinus.

[Collector, Dr. E. A. Mearns.]

U.S.N.M. No.	Sex.	Locality.	Date.	Wing.	Tail.	Exposed culmen.	Tarsus.
189906	Male...	Pandacan, Manila, Luzon Island, Philippine Islands.	Jan. 17, 1902	130.5	143	37.5	12
191843	...do....	Isabella, Basilan Island, Philippine Islands.	Jan. 18, 1904	130.5	149.5	38.5	12
191842	...do....	.....do..........................	Jan. 26, 1904	128.5	140	38	12
190164	...do....	Pantar, Mindanao Island, Philippine Islands.	Aug. 16, 1903	129.5	123	37.5	12
190163	...do....	.....do..........................	.....do.......	130	139.5	35	....
		Average of 5 males...........	....	129.8	139	37.3	12

Measurements of specimens of Merops superciliosus javanicus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Wing.	Tail.	Exposed culmen.	Tarsus.
153762	Male...	Trang, Lower Siam................	Mar. 9, 1896	133	148	39.5	12
153761	...do....	.....do..........................	.....do.......	141	162	40	12.5
175150	...do....	Singapore Island, Strait of Malacca.	Nov. 19, 1899	132	143	39	12
179712	...do....	South Pagi Island, western Sumatra.	Dec. 12, 1902	134	148.5	38.5	10.5
179711	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 26, 1902	132.5	142	40	12.5
		Average of 5 males...........	....	134.5	148.7	39.4	11.9

Family CORACIIDAE.

EURYSTOMUS ORIENTALIS ORIENTALIS (Linnaeus).

Coracias orientalis LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 159 (East Indies; type locality designated by Stresemann [Novit. Zool., vol. 20, 1913, p. 298] as Java).

One specimen, an adult female, No. 179710, U. S. N. M.; from Sibabo Bay, October 24, 1902. Total length in flesh, 288 mm. "Iris dark brown; bill red, tip black; feet red, toes blackish."

From another Simalur Island example and from others taken in Sumatra, Java, Borneo, and Celebes this individual differs very noticeably in having the pileum more decidedly greenish (less brownish); the sides of head and neck more bluish (not so greenish or brownish); the remaining portions of upper surface, including the wings, decidedly more bluish on the green areas; abdomen, sides, flanks, and crissum darker, more bluish (less greenish); jugulum, breast, sides of throat, and all the under wing-coverts decidedly more bluish.

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[1] Ten specimens from India range in wing measurement from 129 to 137 mm., average, 133.3 mm.

Family ALCEDINIDAE.

SAUROPATIS CHLORIS CHLOROPTERA Oberholser.

Sauropatis chloris chloroptera OBERHOLSER, Proc. U. S. Nat. Mus., vol. 55, 1919, p. 379 (Sibabo Bay, Simalur Island, western Sumatra).

Three specimens:

Adult male, No. 179771, U.S.N.M.; Sibabo Bay, October 23, 1902.

Adult male, No. 179769, U. S. N. M.; Sibabo Bay, October 22, 1902. Total length in flesh, 276 mm.

Adult female, No. 179770, U. S. N. M.; Sibabo Bay, October 23, 1902.

All three of these examples show evidences of molt among the contour feathers. The two adult males have a few small dusky edgings on the white cervical collar and on the sides of the breast, due to the fresh condition of their plumage.

RAMPHALCYON CAPENSIS SIMALURENSIS (Richmond).

Pelargopsis simalurensis RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 498 (Simalur Island, western Sumatra).

One adult male, No. 179743, U.S.N.M., taken at Sibabo Bay, October 23, 1902. Total length in flesh, 364 mm. This bird is in the midst of the molt of both quills and contour feathers. It agrees with the type series.

In a recent paper[1] Dr. E. D. Van Oort has transferred the name *Ramphalcyon capensis javana* (Boddaert) to the Philippine bird commonly known as *Ramphalcyon capensis gigantea* (Walden); and the bird from Borneo to which Doctor Sharpe, Doctor Hartert, and the writer have restricted the name *Ramphalcyon capensis javana* he has rechristened *Ramphalcyon capensis innominata.*[2] A careful reexamination of the original description of *Alcedo javana* Boddaert[3] together with the bases of this name, and a comparison of a series of specimens from Borneo and the Philippine Islands with the plate and descriptions show that this change is apparently unwarranted.

The *Alcedo javana* of Boddaert[4] was based primarily on plate No. 757 of d'Aubenton's Planches Enluminées; also on the "*Martin-pêcheur a tête et cou couleur de Paille,*" of Buffon,[5] and the "*White-headed Kingfisher*" of Latham.[6] D'Aubenton's plate is of a rather light bird, though darker than the normal plumage of the Philippine Island *Ramphalcyon capensis gigantea*, particularly on the lower parts; and, while it is paler than the darker examples of the Bornean race, we have specimens from Borneo that match it perfectly. The description given by Buffon,[1] and also that by Latham,[2] which latter is merely a translation of Buffon's, agree with d'Aubenton's plate. From the above facts it will be evident that the name *Alcedo javana* Boddaert would be without violence applicable to some specimens of either the pale Philippine race or the Bornean bird; but in view of the uncertainty thus involved, it is preferable, unless we entirely discard the name as unidentifiable, to allow it to remain on the form that the first revisers selected. In this case the pale Philippine race will continue as *Ramphalcyon capensis gigantea* (Walden), and the Bornean form as *Ramphalcyon capensis javana.* Consequently *Ramphalcyon capensis innominata* Van Oort becomes a synonym of *Ramphalcyon capensis javana* (Boddaert).

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[1] Notes Leyden Mus., vol. 32, Nos. 2–3, April 30, 1910, pp. 125–126.

[2] Idem, p. 126.

[3] Tabl. Planch. Enlum. d'Hist. Nat., 1783, p. 47.

[4] Idem.

[5] Hist. Nat. Ois. (ed. Montbeillard), vol. 13, 1780, p. 280.

[6] Gen. Synop. Birds, vol. 1, pt. 2, 1782, p. 617.

Family HEMIPROCNIDAE.

HEMIPROCNE LONGIPENNIS PERLONGA (Richmond).

Macropteryx perlonga RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 502 (Simalur Island, western Sumatra).

Three specimens:

Adult male, No. 179726, U.S.N.M.; Sibabo Bay, October 22, 1902. Total length in flesh, 225 mm. "Iris dark brown; bill black; feet gray purple."

Adult male, No. 179728, U.S.N.M.; Sibabo Bay, October 24, 1902. Total length in flesh, 220 mm. "Bill black, feet dull dusty purple."

Adult female, No. 179727, U.S.N.M.; Sibabo Bay, October 24, 1902. Total length in flesh, 222 mm.

All these agree with the type series. This seems to be a very distinct form, though but a subspecies of *Hemiprocne longipennis,* since it is connected by individual variation.

Family MUSCICAPIDAE.

MUSCITREA GRISOLA NESIOTIS Oberholser.

Muscitrea grisola nesiotis OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7. October 26, 1912, p. 11 (Sibabo Bay, Simalur Island, western Sumatra).

One specimen, the type of this subspecies, an adult male, No. 179929, U.S.N.M., is in this collection. It was taken at Sibabo Bay on October 24, 1902.

This island race is distinguishable from *Muscitrea grisola grisola* of the Malay Peninsula, by its darker anterior lower parts; darker, more brownish (less grayish) pileum; darker, more rufescent remaining upper surface, the outer edges of the wing-quills being especially more rufescent.

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[1] Hist. Nat. Ois. (ed. Montbeillard), vol. 13, 1780, p. 280.

[2] Gen. Synop. Birds, vol. 1, pt. 2, 1782, p. 617.

Measurements of all the adults from Simalur Island now in the United States National Museum are as follows:

Measurements of specimens of Muscitrea grisola nesiotis.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179929	Male...	Sibabo Bay, Simalur Island, western Sumatra.[b]	Oct. 24, 1902	....	85	65.5	13.5	6	20	12.5
179419	Female	Simalur Island, western Sumatra.	Nov. 21, 1901	165.5	83	63	14.5	6.5	19	12

[a] Measured in the flesh by the collector.

[b] Type.

HYPOTHYMIS AZUREA CONSOBRINA Richmond.

Hypothymis consobrina Richmond, Proc. Biol. Soc. Wash., vol. 15, August 6, 1902, p. 189 (Simalur Island, western Sumatra).

Four specimens:

Adult male, No. 179906, U.S.N.M.; Sibabo Bay, October 21, 1902. Total length in flesh, 161 mm.

Adult male, No. 179905, U.S.N.M.; Sibabo Bay, October 21, 1902. Total length in flesh, 165 mm.

Adult male, No. 179908, U.S.N.M.; October 24, 1902. Total length in flesh, 160 mm.

Juvenal male, No. 179907, U.S.N.M.; Sibabo Bay, October 23, 1902. Total length in flesh, 159 mm.

The adult examples show very little individual variation, and agree perfectly with the type series. The juvenal male is paler below and there much more grayish posteriorly; has the posterior upper parts brown with only a wash of blue; and on the whole looks very much like the female.

TERPSIPHONE AFFINIS PROCERA (Richmond).

Tchitrea procera Richmond, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 510 (Simalur Island, western coast of Sumatra).

Two specimens of this beautiful bird are in the present collection:

Adult male, No. 179903, U. S. N. M., Sibabo Bay, October 22, 1902. Length in flesh, 385 mm. "Bill blue, tip and commissure black; feet leaden blue."

Adult male, No. 179904, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 356 mm. "Inside [of] mouth green; naked orbital skin blue; feet leaden blue."

Both these examples are in the fully adult white plumage. Both show evidences of molt in the rectrices, and one (No. 179903, U.S. N.M.) also in the wing-quills. They agree with the type and other available specimens of *Terpsiphone affinis procera*, a form apparently restricted to the island of Simalur. Comparison of our series with specimens of *Terpsiphone affinis nicobarica*, from the Nicobar Islands, shows, however, that the difference in the color of the head, mentioned by Doctor Richmond in the original description of his *Tchitrea procera*,[a] is not a constant nor a very important character. In most specimens of the latter the metallic sheen on the head is very nearly as greenish as in *Terpsiphone affinis nicobarica*, though in one or two it is appreciably more bluish. There is, however, an average difference in the darker, duller appearance of the pileum and throat in *Terpsiphone affinis procera*, which has also a shorter wing, and is, of course, a recognizable form, though, by reason of individual intergradation with *Terpsiphone affinis nicobarica*, a subspecies of *Terpsiphone affinis*, not a distinct species.

Family PYCNONOTIDAE.

MICROTARSUS ATRICEPS HYPEREMNUS Oberholser.

Microtarsus melanocephalus hyperemnus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 10 (Simalur Island, western Sumatra).

Four specimens:

Adult male, No. 180006, U.S.N.M.; Sibabo Bay, October 22, 1902.
Adult male, No. 180007, U.S.N.M.; Sibabo Bay, October 21, 1902.
Adult male, No. 180008, U.S.N.M.; Sibabo Bay, October 25, 1902.
Adult male, No. 180009, U.S.N.M.; Sibabo Bay, October 23, 1902.

"Iris China blue; bill leaden black; feet black."

These specimens agree with the rest of the type series. In three of them the pileum has a purplish sheen, in the other a greenish.

Measurements of all of the type series are given below.

Measurements of specimens of Microtarsus atriceps hyperemnus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[b]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
180007	Male...	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 21, 1902	180	77	65.5	14.5	5.5	17	10.5
180006	...do....	.....do............	Oct. 22, 1902	180	79	62	14	5	15	12
150009	...do....	.....do............	Oct. 23, 1902	175	77.5	65.5	16	6	15	12.5
180008	...do....	.....do............	Oct. 25, 1902	175	77	64.5	15.5	6	16	12
179324	...do....	Simalur Island, western Sumatra.[c]	Nov. 22, 1901	178	78.5	62.5	14	5.5	15.5	11.5
179819	...do....	.....do............	Dec. 1, 1901	184.5	78	63	14.5	6	14.5	12
173323	...do....	.....do............	Dec. 2, 1901	181	78	64.5	15	6.5	16	12
179321	...do....	.....do............	Dec. 9, 1901	175	78	62.5	14	6	15	12
179322	...do....	.....do............	Dec. 11, 1901	178	76	63	14.5	6.5	15.5	12
179820	...do....	.....do............	Dec. 12, 1901	178	79	62.5	13.5	5	16	12
179318	Female	.....do............	.....do........	171.5	78.5	62.5	13	5	16	12

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[a] Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 510.
[b] Measured in the flesh by the collector.
[c] Type.

Family TURDIDAE.

COPSYCHUS SAULARIS ZACNECUS Oberholser.

Copsychus saularis zacnecus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 12 (Simalur Island, western Sumatra).

A single juvenal female, No. 180076, U.S.N.M., is in the collection. It was taken at Sibabo Bay on October 23, 1902. Length in flesh, 215 mm. It differs from the adult female in having practically all the upper surface, including wings and tail, dull blackish brown, except a small area of bluish metallic feathers on the interscapulum; the white areas in wings more or less washed with buff; chin, throat, and upper breast, dull grayish brown, with broad shaft-streaks of buffy white; and the abdomen medially as well as laterally tinged with dull buff.

This island race differs from the Sumatran bird, heretofore called *Copsychus saularis musicus* (Raffles) by reason of decidedly buff-tinged sides, flanks, and crissum in the male; and more conspicuously dull buffy posterior lower parts in the female.

Measurements of the type series, which includes all our adult Simalur Island specimens, are as follows:

Measurements of specimens of Copsychus saularis zacnecus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179291	Male...	Simalur Island, western Sumatra[b]............	Dec. 2, 1901	222.5	100	91	18.5	30	19.8
179292	...do....	.....do............	Dec. 24, 1901	235	104.5	92.5	20	32	20.5
179293	Female.	.....do............	Dec. 11, 1901	212.5	96.5	85	18	29.5	18.5

[a] Measured in the flesh by the collector. [b] Type.

KITTACINCLA MELANURA HYPOLIZA Oberholser.

Kittacincla melanura hypoliza OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 13 (Simalur Island, western Sumatra).

Three specimens:

Adult male, No. 180087, U.S.N.M.; Sibabo Bay, October 26, 1902. Length in flesh, 264 mm.

Adult female, No. 180085, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 212 mm. Bill black; feet pale purplish fleshy.

Adult female, No. 180086, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 221 mm.

This recently described subspecies differs from *Kittacincla melanura melanura*, of Nias Island, in smaller size; in the somewhat lighter posterior lower parts of the male; and darker posterior ventral surface of the female.

The female of *Kittacincla melanura hypoliza* is smaller than the male, with a decidedly shorter tail; the wings and tail are more brownish; the upper parts and anterior lower surface duller with less metallic sheen; and the posterior lower surface lighter. Both male and female have small whitish tips on the shortest rectrices.

Measurements of all the United States National Museum series of this race are added here for reference.

Measurements of specimens of Kittacincla melanura hypoliza.

[Collector, W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179296	Male...	Simalur Island, western Sumatra............	Nov. 17, 1901	257	86	139.5	16.5	5.5	25.5	16
179300	...do....	.....do.[b].........	Jan. 3, 1902	267	90.5	152	16	6	25	16.5
180067	...do....	Sibabo Bay, Simalur Island, western Sumatra............	Oct. 26, 1902	264	88.5	144	15.5	5.5	24.5	15
180085	...do....	.....do............	.....do........	212	86	101	16	5.5	22.5	15
180086	...do....	.....do............	.....do........	221	84	110	14	5.5	23.5	16

[a] Measured in the flesh by the collector.

[b] Type.

Family SYLVIIDAE.

CISTICOLA CISTICOLA CURSITANS (Franklin).

Prinia cursitans Franklin, Proc. Zool. Soc. Lond., 1831, p. 118 (Hindustan).

Two specimens:

Adult female, No. 179951, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 116 mm.

Adult female, No. 179952, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 111 mm.

Family CORVIDAE.

CORVUS ENCA COMPILATOR Richmond.

Corvus compilator Richmond, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 518 (Simalur Island, western Sumatra).

Two specimens:

Adult male, No. 179877, U.S.N.M.; Sibabo Bay, October 23, 1902.

Adult female, No. 179878, U.S.N.M.; Sibabo Bay, October 23, 1902. Total length in flesh, 473 mm.

Both show evidences of molt among the contour feathers. They agree with other specimens from Simalur Island and indicate that this is a recognizable form. It is, however, a subspecies of *Corvus enca* (Horsfield) from Java.

Family ORIOLIDAE.

ORIOLUS MACULATUS MUNDUS Richmond.

Oriolus mundus RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 517 (Simalur Island, western coast of Sumatra).

Three specimens:

Adult male, No. 179879, U.S.N.M.; Sibabo Bay, October 23, 1902. "Bill purple pink, pale towards tip."

Adult male, No. 179881, U.S.N.M.; Sibabo Bay, October 22, 1902. "Bill pink, pale towards tip; feet leaden; iris deep red."

Juvenal male, No. 179880, U.S.N.M.; Sibabo Bay, Simalur Island, October 26, 1902.

The adult male taken on October 22 shows some indications of molt among the contour feathers; and the juvenal male is molting both quills and contour feathers. The juvenile differs from the adult in being of a duller yellow below; duller, more olivaceous yellow above; in having the middle tail-feathers brownish, overlaid with yellowish olive, and the wing-quills deep brown or brownish black edged with yellowish olive.

These additional specimens bear out the characters of this oriole originally given by Dr. C. W. Richmond;[1] though *Oriolus mundus* is certainly but a subspecies of *Oriolus maculatus* Vieillot, since *Oriolus maculatus richmondi*[2] is intermediate, and by individual variation bridges the gap in characters.

Measurements of these specimens are given below.

Measurements of specimens of Oriolus maculatus mundus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179879	Male....	Sibabo Bay, Simalur Island.	Oct. 23, 1902	282	149	104	33	11.5	25	19
179881	...do....	.....do............	Oct. 22, 1902	283	150	103	36	11.5	26.5	18.5
179880	Male juv.	.....do............	Oct. 26, 1902	272	140.5	97.5	....	11.5	25	19.5

[a] Measured in the flesh by the collector.

Family CAMPEPHAGIDAE.

ARTAMIDES SUMATRENSIS SIMALURENSIS (Richmond).

Graucalus simalurensis RICHMOND, Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 513 (Simalur Island, western coast of Sumatra).

Two specimens:

Adult male, No. 179897, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 297 mm. "Iris straw yellow; bill and feet black."

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[1] Proc. U. S. Nat. Mus., vol. 26, Feb. 4, 1903, p. 517.

[2] Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, Oct. 26, 1912, p. 16 (North Pagi Island, western Sumatra).

Adult female, No. 179898, U.S.N.M.; Sibabo Bay, October 26, 1902. Total length in flesh, 290 mm. "Iris pale greenish yellow; bill and feet black."

These agree perfectly with those previously obtained by Doctor Abbott, and from which Dr. C. W. Richmond described his *Graucalus simalurensis.*[a] This form is, however, clearly a subspecies of *Artamides sumatrensis*, with which it intergrades by individual variation, at least through other races of this species.

PERICROCOTUS IGNEUS TROPHIS Oberholser.

Pericrocotus igneus trophis OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 14 (Simalur Island, western Sumatra).

Three specimens:

Adult male, No. 179900, U.S.N.M.; Sibabo Bay, October 26, 1902. "Iris dark brown; bill and feet black."

Adult female, No. 179901, U.S.N.M.; Sibabo Bay, October 21, 1902.

Adult female, No. 179902, U.S.N.M.; Sibabo Bay, October 26, 1902. "Bill black; feet brownish black."

These agree with the type and the other Simalur Island specimens of *Pericrocotus igneus trophis.* The present race is decidedly larger than *Pericrocotus igneus igneus* Blyth, from the Malay Peninsula, and this character alone will serve for its separation. With the series now available we are not able to make satisfactory color comparisons with *Pericrocotus igneus igneus*, so that there may be differences of this kind also.

Measurements of all the United States National Museum specimens of this race are subjoined.

Measurements of specimens of Pericrocotus igneus trophis.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[b]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179224	Male...	Simalur Island, western Sumatra.[c]	Dec. 8, 1901	171.5	80	77	11	16.5	11
179223	...do....	Sibabo Bay, Simalur Island, western Sumatra.	.....do........	168.5	77.5	75.5	11.8	15.2	11
179900	...do....	.....do............	Oct. 26, 1902	167	78.5	76.5	11	16	10
179901	Female	.....do............	Oct. 21, 1902	170	80.8	77	11	17	10
179902	...do....	.....do............	Oct. 26, 1902	155	76	69	11.2	16	10

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[a] Proc. U. S. Nat. Mus., vol. 26, February 4, 1903, p. 513.

[b] Measured in the flesh by the collector.

[c] Type.

PERICROCOTUS ANDAMANENSIS MINYTHOMELAS Oberholser.

Pericrocotus andamanensis minythomelas OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 14 (Simalur Island, western Sumatra).

One adult male, No. 179899, U.S.N.M., taken at Sibabo Bay, on October 25, 1902, is in the collection. It has a few orange-colored feathers in the black throat. Otherwise it agrees with the type and the rest of the type series of *Pericrocotus andamanensis minythomelas*.

The Simalur Island race differs from *Pericrocotus andamanensis flammifer* Hume, of Tenasserim and the Malay Peninsula, in its larger size, the tail being especially long; also, in the male, in having generally more reddish orange on the outer webs of tertials, and in having the inner webs of middle rectrices black to the tips, instead of usually more or less tipped with reddish orange. From *Pericrocotus andamanensis modiglianii* Salvadori, of Engano Island, it may readily be distinguished by its smaller size; also, in the male, by more extensive reddish orange markings on the distal portion of the outer webs of tertials, and less black, or none, on the outer webs of middle pair of tail-feathers; in the female, by decidedly darker upper parts, more deeply and more extensively yellow forehead, more deeply yellow wing markings, and more richly yellow lower surface.

Measurements of the entire type series of this subspecies, which includes all the Simalur Island specimens in the United States National Museum, are given herewith.

Measurements of specimens of Pericrocotus andamanensis minythomelas.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179228	Male...	Simalur Island, western Sumatra.	Dec. 1, 1901	206.5	92	87.5	14.5	16.5	13
179230	...do....	.....do...........	.....do.........	203	90	89	14	16	12
179225	...do....	.....do...........	Dec. 7, 1901	190.5	90	81	15	16.5	12
179231	...do....	.....do...........	.....do.........	193.5	91.3	83.5	14	16	12
179226	...do....	.....do.[b]	Dec. 12, 1901	197	91	87.8	13.5	16.5	13.3
179229	...do....	.....do...........	Dec. 14, 1901	203	93.5	89.5	14	17	13
179227	...do....	.....do...........	Dec. 23, 1901	190.5	89.5	85.5	13	15.5	11
179899	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 25, 1902	....	91	89	14	17	12
179232	Female.	Simalur Island, western Sumatra.	Dec. 7, 1901	182.5	87.5	82	12.5	16	12
179233	...do....	.....do...........	Dec. 14, 1901	190.5	87	81	13	15.5	12
179234	...do....	.....do...........	Dec. 23, 1901	197	89	82	13.5	16.2	12

[a] Measured in the flesh by the collector.

[b] Type.

Family EULABETIDAE.

LAMPROCORAX PANAYENSIS RHADINORHAMPHUS **Oberholser.**

Lamprocorax chalybeus rhadinorhamphus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 17 (Simalur Island, western Sumatra).

A single adult female, No. 179871, U.S.N.M., taken at Sibabo Bay on October 24, 1902, agrees with the type of *Lamprocorax panayensis rhadinorhamphus*, but is even duller, and with an even more pronounced purplish bronzy sheen, both above and below. The iris is given on the label as red.

This Simalur Island subspecies appears to be most closely allied to *Lamprocorax panayensis altirostris* (Salvadori), but it differs from that in its duller plumage, with a more purplish bronzy (less purely greenish) sheen, especially on the upper surface, and in usually somewhat more slender bill. From Sumatran examples of *Lamprocorax panayensis strigatus* (Horsfield) it may be distinguished by its much heavier bill, and by the same peculiarities of plumage as from *Lamprocorax panayensis altirostris.*

Measurements of our Simalur Island adults are as follows:

Measurements of specimens of Lamprocorax panayensis rhadinorhamphus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179272	Male...	Simalur Island, western Sumatra.[b]	Dec. 12, 1901	206	100.5	62	16.5	8	22	17
179871	Female.	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 24, 1902	201	99	62	16.5	8	22	16.5

[a] Measured in the flesh by the collector. [b] Type.

Family DICRURIDAE.

DICRURUS CINERACEUS CELAENUS **Oberholser.**

Dicrurus cineraceus celaenus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 15 (Simalur Island, western Sumatra).

Three specimens:

Adult male, No. 179826, U.S.N.M.; Sibabo Bay, October 22, 1902. “Bill and feet black.”

Adult male, No. 179827, U.S.N.M.; Sibabo Bay, October 21, 1902. “Iris red.”

Adult female, No. 179825, U.S.N.M.; October 23, 1902. “Iris red; ill and feet black.”

All three are molting both quills and contour feathers. They agree completely with the other specimens of the type series.

This is a very readily recognizable race, differing from *Dicrurus cineraceus cineraceus* of Java in its much darker coloration, particularly on the lower parts. The wings and tail are also darker, though not so decidedly. It is, however, clearly a subspecies of *Dicrurus cineraceus*, as its individual variation indicates.

Measurements of all the type series are added below.

Measurements of specimens of Dicrurus cineraceus celaenus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179248	Male...	Simalur Island, western Sumatra.[b]	Nov. 27, 1901	273	136.5	135	21	18	12.5
179250	...do....	.....do............	Nov. 29, 1901	279.5	134.5	137	21	19	13
179247	...do....	.....do............	Nov. 17, 1901	267	131	128	21.5	18.3	13
179251	...do....	.....do............	Dec. 1, 1901	276.5	133	135	22.3	19	13
179826	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 22, 1902	276	134	133.5	21	19	13
179827	...do....	.....do............	Oct. 21, 1902	260	126	118	20.5	20	11.8
179249	Female	Simalur Island, western Sumatra.	Nov. 19, 1901	267	128.5	128.5	20	19	12
179246	...do....	.....do............	.....do........	257	128.5	126.5	22	19	12
179825	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 23, 1902	276	130	135.5	20	18	12.6

[a] Measured in the flesh by the collector.
[b] Type.

DISSEMURUS PARADISEUS OLIZURUS Oberholser.

Dissemurus paradiseus olizurus OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 15 (Simalur Island, western Sumatra).

Three specimens:

Adult female, No. 179836, U.S.N.M.; Sibabo Bay, October 22, 1902. Total length in flesh, 443 mm.

Adult female, No. 179838, U.S.N.M.; Sibabo Bay, October 26, 1902.

Female, not quite adult, No. 179837, U.S.N.M.; Sibabo Bay, October 25, 1902. Total length in flesh, 386 mm. "Iris dark brown; bill and feet black."

These specimens agree with the type and others of the type series, of which indeed they form a part, in differing from eastern Sumatran examples of *Dissemurus paradiseus paradiseus* in shorter wing and tail, shorter tail-racquet, and somewhat slenderer bill.

Measurements of all our Simalur Island birds are given below:

Measurements of specimens of Dissemurus paradiseus olizurus.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Wing.	Tail.	Tail except outer feathers.	Total culmen.	Height of bill at base.	Tarsus.	Length of racquet.	Greatest width of racquet.	Length of frontal crest.
179243	Male...	Simalur Island, western Sumatra.	Nov. 18, 1901	142	313	140	31	11.5	24	68.5	18.5	7
179242	...do....	.....do.[a]...........	Nov. 19, 1901	140	309.5	133.5	32	11	23	67.5	18.5	6.5
179244	Female	.....do.............	.....do........	138	291	139	31	11	22.5	72	17.5	8
179838	...do....	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 26, 1902	139.5	298	141	29.5	11	22.5	70.5	18.5	6.5
179837	...do....	.....do.............	Oct. 25, 1902	133	......	131.5	29	11.5	23.5	67.5	15.5	7
179836	...do....	.....do.............	Oct. 22, 1902	142	279	141	31.5	10.5	22	69	17	6.5

[a] Type.

Family MOTACILLIDAE.

DENDRONANTHUS INDICUS (Gmelin).

[*Motacilla*] *indica* GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 962 (India).

One adult male is in this collection, No. 179942, U.S.N.M., taken at Sibabo Bay on October 25, 1902. Total length in flesh, 165 mm.

The use of the generic name *Dendronanthus* Blyth for this species has already been explained by Dr. C. W. Richmond.[1]

Family NECTARINIIDAE.

CINNYRIS BRASILIANA MECYNORHYNCHA Oberholser.

Cinnyris brasiliana mecynorhyncha OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 19 (Simalur Island, western Sumatra).

A single adult male, No. 180053, U.S.N.M., from Simalur Island, taken, October 23, 1902, agrees with the type.

I have unfortunately been able to see no females of this race, so that I am unable to state the color differences, if any, that obtain between females of the present race and those of its nearest allies. The males, however, are sufficiently distinguished from the same sex of *Cinnyris brasiliana brasiliana*,[2] of Java, by decidedly larger size, particularly of the bill, and in somewhat darker posterior lower parts; and from *Cinnyris brasiliana oenopa* Oberholser,[3] of Nias Island, by the much larger bill, slightly longer wing, tail, and tarsus.

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[1] Proc. U. S. Nat. Mus., vol. 26, Feb. 4, 1903, p. 504.

[2] For explanation of the change of the name of this species from *Cinnyris hasseltii* (Temminck) to *Cinnyris brasiliana* Gmelin, see Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 18.

[3] *Cinnyris brasiliana oenopa* Oberholser, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 18.

Measurements of the above-mentioned specimen and of the type are subjoined.

Measurements of specimens of Cinnyris brasiliana mecynorhyncha.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179396	Male...	Simalur Island, western Sumatra.[b]	Nov. 19, 1901	108	48.5	29.5	16	3	13.5	8
180053	...do...	......do...........	Oct. 23, 1902	108	49	29.5	15.5	8	13.5	9

[a] Measured in the flesh by the collector. [b] Type.

AETHOPYGA SIPARAJA TINOPTILA Oberholser.

Aethopyga siparaja tinoptila OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 17 (Pulo Siumat, near Simalur Island, western Sumatra).

A single adult male, No. 180054, U.S.N.M., from Sibabo Bay, Simalur Island, taken, October 24, 1902, agrees with our other examples from Simalur Island, and with the type of *Aethopyga siparaja tinoptila* from Pulo Siumat, near Simalur Island. The present race differs from Sumatra representatives of *Aethopyga siparaja siparaja* in its slightly larger average size; also, in the male, in having the olivaceous posterior lower parts less greenish (more grayish), and the lower breast usually more extensively blackish; and, in the female, in having a darker, duller, and rather more ashy lower surface. It is so much larger than *Aethopyga siparaja niasensis* Hartert, that it is by this character alone readily distinguishable.

For purposes of comparison, measurements of all the United States National Museum series of this race from Simalur Island, and of the type from Pulo Siumat, are given below.

Measurements of specimens of Aethopyga siparaja tinoptila.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Tarsus.	Middle toe without claw.
179410	Male..	Pulo Siumat, near Simalur Island, western Sumatra.[b]	Dec. 28, 1901	114.5	54	44	14	12.8	8
179408	...do...	Simalur Island, western Sumatra.	Nov. 21, 1901	108	51	41	15.5	12.8	8
179409	...do...	.....do............	.....do.......	111	50	40.5	14.2	13	8
180054	...do...	Sibabo Bay, Simalur Island, western Sumatra.	Oct. 24, 1902	119	50.5	42.5	15	14	8.5
179407	Female.	Simalur Island, western Sumatra.	Nov. 22, 1901	102	46.5	34	13.7	12	8

[a] Measured in the flesh by the collector. [b] Type.

Family DICAEIDAE.

DICAEUM TRIGONOSTIGMUM ANTIOPROCTUM Oberholser.

Dicaeum trigonostigma antioproctum OBERHOLSER, Smiths. Misc. Coll., vol. 60, No. 7, October 26, 1912, p. 21 (Simalur Island, western Sumatra).

One specimen, an adult male, No. 180070, U.S.N.M., taken on Simalur Island, October 26, 1902, agrees perfectly with the type.

This island race is readily separable from *Dicaeum trigonostigmum trigonostigmum*, of the Malay Peninsula, by its much more greenish yellow (less orange) rump; and not quite so deeply orange posterior lower parts. There seems to be no difference in size.

Measurements of the present specimen and of others in the United States National Museum are added below:

Measurements of specimens of Dicaeum trigonostigmum antioproctum.

[Collector, Dr. W. L. Abbott.]

U.S.N.M. No.	Sex.	Locality.	Date.	Total length.[a]	Wing.	Tail.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe without claw.
179898	Male...	Simalur Island, western Sumatra.[b]	Nov. 25, 1901	95.5	49	22	10	3.5	13	8
180070	...do...	.....do..........	Oct. 26, 1902	....	50	24.5	10.8	3.8	13.5	8.5
179899	Female.	.....do..........	Dec. 3, 1901	95.5	49	22	10	4.5	13	8

[a] Measured in the flesh by the collector.

[b] Type.

Family PLOCEIDAE.

MUNIA MAJA (Linnaeus).

[*Loxia*] *Maja* LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 301 (East Indies).

One adult female is in the collection, No. 180099, U.S.N.M., from Sibabo Bay, taken, October 26, 1902. Total length in flesh, 123 mm. "Bill pale lavender; feet leaden."

This example is apparently not different from Malay Peninsula birds.

DESCRIPTIONS OF NEW SPECIES OF CHITONS FROM THE PACIFIC COAST OF AMERICA.

By William Healey Dall,
Honorary Curator of Mollusks, United States National Museum.

In reviewing the West American Mollusca for the purpose of completing a checklist of Pacific coast Gastropoda, a large number of Chitons which appeared to be undescribed were found in the collection. Part of these were minute, and in the fear that with more thorough study than it was in my power to give at this time they might prove to be young of species already known, and in view of the well-known variability of many groups of these animals it was thought best to omit them from consideration at present. The others are now described. I have intentionally referred them to the larger groups on account of the difficulty in determining the value of subdivisions which have been proposed by recent writers. As the specimens were all dry it has been impossible in a number of cases to determine the extent of the gill rows, but this has been stated whenever practicable. The dried specimens, being in various stages of contraction, it will be understood that the measurements given merely approximate those of the living animals.

There is little doubt that the west coast of America is the richest Chiton region in the world, that many new forms remain to be discovered and that a satisfactory classification will in time be worked out. The present paper is a small contribution toward that end.

LEPIDOPLEURUS (LEPTOCHITON) AMBUSTUS, new species.

Chiton with a rather high but rounded back, the valves reddish-brown with numerous blackish flecks, giving the interspaces a somewhat vermicular aspect; anterior valve semicircular, simple; posterior valve smaller, shorter, with a subcentral prominent mucro behind which the surface is concavely excavated; intermediate valves subequal, dorsally rounded with hardly any trace of lateral areas; sculpture of the valves nearly uniform fine equal grooves, axially on the dorsal area, oblique on the lateral areas and cut by still finer transverse striae into microscopic granulations; the distal ends of the middle valves in the adult shell with concentric undulations; insertion plates short, entire; girdle with crowded arenaceous, short spinules, interspersed near the valve margins with sparse longer white spines, the body of the girdle partaking of the colors of the shell, with a silvery reflection in certain aspects; extreme edge of the eaves finely striated in accordance with the exterior sculpture; interior whitish, the jugal sinus obscure, the sutural laminae narrow, arcuate, widely separated; a conspicuous median excavation bordered behind by two winglike, radially grooved, narrow callosities on the internal face of the valve under the central area of the posterior valve. Length of valves, 17; width, 8; height, 3 mm.

Habitat.—Santa Barbara Channel in 20 to 40 fathoms; F. A. Woodworth. Cat. No. 274120, U.S.N.M.

This has somewhat the aspect of the European *Chiton asellus* Spengler, which, however, has a differently clothed girdle and is proportionately wider and shorter.

It has been known for some years under the above manuscript name, having been by inadvertence omitted from a paper in which other chitons were described in 1902.

LEPIDOPLEURUS (LEPTOCHITON) LYCURGUS, new species.

Chiton minute, white, with touches of brown on either side of the jugal area; dorsum rather angular with flattened sides; anterior valve less than semicircular, its edge excavated behind, simple; posterior valve axially longer, with a prominent smooth subcentral mucro over a concave posterior slope; central area axially grooved, minutely granulose; posterior area with radial granulose very minute sculpture; intermediate valves with no marked jugal area, that and the pleural tracts with oblique minute reticulations; lateral areas distinct, radially minutely striate-punctate, with some obscure concentric undulations distally; girdle spiculose with minute white spinules of uneven length; interior whitish. Length of valves, 4.5; width, 3; height, 1 mm.

Habitat.—Catalina Island, California, between tides, collected by W. H. Dall. Cat. No. 274119, U.S.N.M.

LEPIDOPLEURUS (LEPTOCHITON) OLDROYDI, new species.

Chiton white, with a blackish spot on either side of the jugal area, strongly sculptured; back moderately arcuate, anterior valve semicircular, sculptured with irregularly disposed small prominent round pustules; posterior valve with subcentral prominent mucro, the central area granulose, the periphery pustulose; intermediate valves with axially puncto-striate jugal area, lateral areas prominent by reason of the conspicuous pustules which are relatively large for the size of the animal; the pleural tracts coarsely axially grooved, the grooves more or less distinctly punctate; girdle with crowded minute spines of equal length, giving an arenaceous effect; interior whitish, the jugal sinus wide with a straight edge, the sutural laminae small, subtriangular. Length of dry animal, 5; width 2; height, 0.7 mm.

Habitat.—Monterey, California. Cat. No. 218767, U.S.N.M.

This species was discriminated by Dr. Paul Bartsch some years ago, but not published.

LEPIDOPLEURUS (LEPTOCHITON) AGESILAUS, new species.

Chiton small, with a rounded back and very narrow girdle, the valves white, but coated with a black deposit (manganese ?) which obscures the sculpture; anterior valve nearly semicircular, with almost microscopic radial striation decussated by concentric even finer striae; posterior valve with a moderately prominent mucro slightly in front of the center, the central area finely axially puncto-striate, the posterior area radiately striate, the ridges more or less granulose from intersection by concentric striation; intermediate valves with obscure concentrical undulations which make the posterior edge irregularly denticulate; pleural tracts and undifferentiated jugal area axially minutely puncto-striate; girdle minutely densely spinose, the ends of the spinulae forming an arenaceous even surface except at the outer margin which has a short fringe of slightly longer whitish spinules; interior whitish, the jugal sinus obsolete, the sutural laminae small, narrow. Length of animal, 8; width, 5; height, 3 mm. Gills ambient.

Habitat.—Straits of Magellan in 61 fathoms sand, bottom temperature 48° Fahrenheit. United States Fish Commission steamer *Albatross*. Cat. No. 96227, U.S.N.M.

One of the specimens has only half the seventh valve developed, the vacant space being covered by a widening of the sixth valve on that side.

LEPIDOPLEURUS (LEPTOCHITON) NICOMEDES, new species.

Chiton of moderate size, yellowish white, with a moderately wide girdle covered with an even pavement-like series of nearly rectangular subequal ivory-white smooth scales set in radial lines; back almost keeled, the mucrones of the intermediate valves prominent and whiter than the rest of the surface; anterior valve semicircular with faint granular minute radial threads, and a general sculpture of very minute reticulation; posterior valve with a small mucro at the anterior third, the central area narrow and faintly concentrically sculptured; the posterior area somewhat concave, sculptured like the anterior valve; intermediate valves without distinct jugal area, that and the pleural tracts sculptured only with a microscopic decussation; lateral areas conspicuous, with about three radial low coarsely granular ribs; interior whitish; jugal sinus inconspicuous, the sutural laminae long, narrow. Length of shell, 10; width, 6.5; height, 4 mm. Gill rows about two-thirds as long as the foot.

Habitat.—Off Nelson Strait, southern Chile, in latitude south 51°, 52′, in 348 fathoms, mud, bottom temperature 49.9°; United States Fish Commission steamer *Albatross*. Cat. No. 96935, U.S.N.M.

NUTTALLINA ALLANTOPHORA, new species.

Chiton with the broad flattish valves of *N. magdalena*, feebly mucronate, black, with the girdle set with black, white, and brown slightly curved stout sausage-shaped spines, smaller toward the margin, some over a millimeter long; the interior of the valves a very dark green with a very wide shallow sinus; anterior valve semicircular with a white ray, covered with minute pustules, partly ocular, and a microscopic decussation; posterior valve small and axially narrow with a posterior mucro and sculpture like that on the head valve; intermediate valves with the jugal area not distinct from the pleural tracts and the lateral areas indicated only by a faint elevation above the pleural tracts and sculptured like the rest of the shell. Length, 25; width of valves, 15; height, 6 mm.

Habitat.—Los Animás Bay, W. J. Fisher. Cat. No. 110360 *a*, U.S.N.M.

The armature of the girdle is quite sufficient to distinguish this from any of the related species.

NUTTALLINA MAGDALENA, new species.

Chiton of moderate size with a wide dusky girdle covered with dense microscopic spinules so as to form a velvety surface with a few long white spines, more abundant toward the edge of the girdle, which with a very narrow strip crosses the region between the valves; the general color is greenish or purplish black, with whitish streaks along the dorsal ridge; the interior is greenish, or white with green in the jugal sinuses; anterior valve with 7 to 9 slits, the outer side of the insertion plates striated; posterior valve with seven slits, the insertion plates smooth; the intermediate valves with one slit at each end; anterior valve semicircular with irregularly scattered globular pustules and a microscopic fine decussation; posterior valve wide, short, with terminal mucro, the central area with axial beaded threads with wider interspaces, the posterior tract pustulate; the intermediate valves mucronate, with the jugal area simply axially threaded; the pleural tracts with more or less oblique beaded threads merging laterally into rows of pustules; the lateral areas smooth, not ribbed, with sparsely scattered pustules; internally with the jugal sinus very wide and shallow, the sutural laminae long and wide. Length, 26; width, 12; height, 7 mm.

Habitat.—Magdalena Bay, Lower California, C. R. Orcutt. Cat. No. 217924, U.S.N.M.

This species has very much wider and less interrupted valves than either of those previously described, while it is destitute of the strong ribbing which they display and has different minor sculpture.

ISCHNOCHITON MARMORATUS, new species.

Chiton small, elegantly marbled with white, gray, and brown, with a velvety girdle covered with mottled gray, white, and brown densely set spinules; anterior valve with about 12 radial rows of prominent pustules, the rows sometimes bifid, and the ground microscopically decussate; slits 8–10; posterior valve smaller, with 8–9 slits, the mucro slightly behind the center with a peripheral irregularly double row of pustules while the central area is coarsely axially reticulate; intermediate valves with one slit, hardly mucronate, the jugal and pleural tracts axially sculptured with beaded threads finer on the jugum; lateral areas with two or three radial rows of prominent pustules which near the girdle project like little cylinders in an irregular manner; interior whitish, with hardly perceptible jugal sinuses and very narrow sutural laminae. Length, 7; width, 4; height, 1.5 mm.

Habitat.—Pacific Grove, Monterey Bay, California; Mrs. Blood. Cat. No. 218735, U.S.N.M.

Remarkable for its unusually projecting pustular sculpture. *Chiton marmoratus* Gmelin, belongs to another genus.

ISCHNOCHITON BRYANTI, new species.

Chiton of moderate size, flattish, with dorsal keels, a girdle with oval smooth small imbricating scales mottled with light and dark brown, the valves light olivaceous brown with blackish flecks; anterior valve less than semicircular, with about 13 rather irregular, sometimes bifurcate, thread-like beaded radial riblets, the whole surface covered by a microscopic reticulation; internally there are 13–14 slits, the insertion plates radiately striated; posterior margins denticulate, the jugal sinus shallow and small; posterior valve smaller, the general sculpture on the posterior area like that of the anterior valve, internally with 11 slits, the sinus shallow, the sutural laminae narrow, the insertion plates striated; intermediate valves axially short, slightly mucronate, keeled; the jugal area minutely decussate; pleural tracts with 8–10 prominent axial threads and 6–8 finer transverse threads in the interspaces, the whole valve covered with the minute decussation; lateral areas with two strong radial minutely nodulous ribs bifurcate distally, the posterior rib annulate, denticulating the margin; internally whitish, with a shallow jugal sinus and one slit in each end. Length, 9; width, 5.5; height, 2 mm.

Habitat.—"California," F. W. Bryant. Cat. No. 253826, U.S.N.M.

This species has the gill rows ambient, and the striated insertion plates are peculiar. It came to the United States National Museum with the Bryant collection and without any more definite locality than that above given, but most of his shells were from the southern part of the State.

ISCHNOCHITON BRUNNEUS, new species.

Chiton of moderate size, flattish, of a yellowish brown with a few black flecks on the girdle, which is armed with smooth oval slightly imbricating scales; anterior valve with 11, posterior with 14, intermediate with single slits; anterior valve with about 16 beaded radial ribs sometimes bifurcate, the posterior margin denticulate, the interspaces microscopically reticulate; posterior valve flattish, the mucro slightly behind the center, with about 14 sometimes bifid rows of pustules with the same reticulate ground; the central area is sculptured like the pleural tracts of the intermediate valves; the latter valves have a nearly smooth mucro and feeble dorsal carination; the pleural tracts have 8 or 10 axial undulated threads on each side, beneath which are more closely set coarser transverse threads with deeply punctate interstices; the lateral areas have three or four radial ribs, the posterior annulate, denticulating the posterior margin, the others beaded, the substratum everywhere with the minute reticulation. Length, 18; width, 12; height, 3 mm.

Habitat.—San Diego, California, Henry Hemphill. Cat. No. 58734 *a*, U.S.N.M.

ISCHNOCHITON LISTRUM, new species.

Chiton of moderate size, straw color, with occasional black blotches on the girdle, which is densely minutely scaled; though the shell is flattish, the dorsum is nearly keeled, but the valves are hardly mucronate; the gill row lacks one-fourth of being ambient; the anterior valve has 12, the posterior 11, the intermediate single slits; the anterior valve has about 16 thread-like beaded radial riblets, the two marginal ones are large with half a dozen sharp denticles on the edge; the whole shell is covered under its stronger sculpture with very minute reticulation; the posterior valve is smaller and has 14 riblets like those on the anterior valve; the central area is smaller, the mucro being low and behind the center; it is sculptured like the pleural tracts; intermediate valves with a small nearly smooth jugum, the pleural tracts with about a dozen axially straight slender threads on each tract, with subequal and closer transverse threads in the interspaces with deep interstices; the lateral areas have two or three slender beaded radii on a flat substratum anteriorly, but on the posterior side there is a wider rib with five or six widely spaced annulations, which are projected backward like the teeth of a comb, beyond the margin; internally the valves are whitish. Length, 12; width, 8; height, 2.3 mm.

Habitat.—San Diego, California, Henry Hemphill. Cat. No. 58734 *b*, U.S.N.M.

The peculiar sculpture of the lateral areas is the most conspicuous character of this species.

ISCHNOCHITON RITTERI, new species.

Chiton of moderate size, brownish, darker on the prominences, with a rather wide girdle set with smooth oval convex whitish imbricating scales, the valves nearly mucronate, almost keeled; anterior valve with about 20 flattish radii with narrower interspaces, the whole covered with a minute oblique decussation; internally whitish, with 16 slits, the insertion plates smooth, the eaves very narrow; posterior valve with a nearly central low mucro, the posterior tract sculptured like the anterior valve but more faintly, the central area punctate-reticulate; internally whitish, with 12 slits, the sinus defined by small notches at each end, straight edged, the sutural laminæ narrow, elongate; intermediate valves (the first larger than the others) with no defined jugal area, but deeply punctate-reticulate, the punctations coarser toward the margins of the pleural area, lateral areas with three flattish radii with narrower interspaces, all covered with the minute reticulation; internally white with two slits at each end, one sometimes obsolete; the sinus wide, concave, shallow, between two faint notches, the sutural laminæ narrow; gill rows ambient. Length, 22; width, 15; height, 5 mm.

Habitat.—Channel at Juneau, Alaska, Harriman Alaska Expedition, collected by Professor W. E. Ritter. Cat. No. 218759, U.S.N.M.

? ISCHNOCHITON EXANTHEMATUS, new species.

Chiton of moderate size, of dark yellowish brown color, lighter on the jugum, the girdle covered with densely set short spinules whose ends form a minute tessellation on the surface; anterior valve less than semicircular, sculptured with concentric incremental lines and over the entire surface with very minute granular pustules; internally with about 18 slits, with very short smooth insertion plates and rather spongy eaves; the posterior valve has similar sculpture on the posterior area, the low mucro at the anterior fourth of the valve and the narrow central area merely transversely striated; internally there are 14 slits, the insertion plates faintly striated in part, the sutural laminae very narrow, the sinus hardly perceptible, the color white; intermediate valves hardly mucronate, the jugal area smooth except for microscopic punctations, the pleural tracts with seven or eight axial thread-like lines with wider interspaces, minutely punctate, on each side; the lateral areas feebly concentrically ribbed and granulose like the end valves; internally with one or two slits indifferently on the same valve, the sinus wide, very shallow and ill-defined, the sutural laminae narrow, arcuate. Length, 10; width, 7; height, 4 mm.

Habitat.—Straits of Magellan in 61 fathoms, sand, bottom temperature 48°, United States Fish Commission steamer *Albatross.* Cat. No. 96226, U.S.N.M.

ISCHNOCHITON OPHIODERMA, new species.

Chiton oval, dull flesh color, with greenish flecks, internally bluish green, girdle with oval white convex smooth scales of about equal size, the back low, rounded; anterior valve less than semicircular, with impressed incremental lines, the surface covered with flat rectangular or lozenge-shaped scalelike sculpture resembling snake skin, internally with nine slits, and smooth insertion plates; posterior valve with the mucro moderately prominent, in front of the center, the posterior tract sculptured like the head valve, the central area with extremely fine, somewhat oblique axial threadlets crossed by incremental lines; internally with nine slits, a rather wide straight-edged sinus and quite narrow sutural laminae; intermediate valves with no differentiated jugum, that area and the pleural tracts continuous, sculptured with a very fine oblique reticulation; lateral areas with the "snake-skin" sculpture, without ribs; internally with one slit at each end, a wide straight-edged sinus and arcuate sutural laminae. Length, 15; width, 12; height, 4 mm.

Habitat.—Panama, James Zetek (No. 574). Cat. No. 332145. U.S.N.M. The "snake-skin" sculpture recalls that on *Acanthochitona*, but is more compact.

ISCHNOCHITON ACELIDOTUS, new species.

Chiton whitish, of moderate size, with high but not keeled back, the entire surface except the lateral areas covered with a microscopic oblique reticulation; the girdle provided with densely set small spinules, whose distal ends appear at the surface to form a regular pavement of small lozenge-shaped scales; the gill rows advance to the second valve; anterior valve smooth, except for the microscopic decussation, internally with 14 slits; posterior valve with the same number, the mucro in front of the center, the posterior tract sculptured like the anterior valve, the central area like the intermediate valves; the latter have a smooth space in the mucronate jugal area, the pleural tracts have six to eight widely spaced slender axial threads; the lateral areas incremental lines and extremely minute pustulation. Length, 14; width, 9; height, 5 mm.

Habitat.—Magellan Straits in 77½ fathoms, ooze, bottom temperature 46.9°, United States Fish Commission steamer *Albatross*. Cat. No. 122731, U.S.N.M.

ISCHNOCHITON MARIPOSA, new species.

Chiton small, profusely marbled with red, white, green, and gray; the pattern different in each specimen, the anterior and second valve conspicuously longer axially and somewhat higher than those succeeding them, the girdle maculated with alternate lighter and darker patches; the back rather low, not forming a ridge at the jugum;

anterior valve with 9, posterior with 8, intermediate valves with 1 slit at each end; the anterior valve is less than semicircular and is obscurely granulose; the surface of all the valves is polished; posterior valve is small, with low subcentral mucro, the central area axially grooved, the posterior area with low granules interspersed with punctations; intermediate valves with the jugal area nearly smooth or with faint punctations, but not definitely differentiated from the pleural tracts, which are sharply grooved in a generally axial but more or less vermicular manner; the lateral areas are denticulate on their posterior edges and irregularly divaricately strongly ridged; the armature of the girdle is composed of minute densely imbricated scales; the gill rows are ambient; the jugal sinus shallow, with a straight edge, the sutural laminae subrectangular, wide apart. Length of shell, 8; width, 4.5; height, 3 mm.

Habitat.—Gulf of California, W. J. Fisher. Cat. No. 58865, U.S.N.M.

This is another of Dr. Paul Bartsch's manuscript species.

ISCHNOCHITON BERRYI, new species.

Chiton of moderate size, deep crimson with irregular blotches of brown and white on its lateral slopes, and a crimson girdle of rounded densely imbricated small scales; gill rows ambient; anterior valve with a nearly smooth mucro, from which radiate about 20 more or less corrugated, sometimes bifurcating threads, the whole overspread like the rest of the shell by an almost microscopic decussation; anterior slits about 12; posterior valve much smaller with a subcentral mucro, from which radiate threads, like those on the anterior valve, in all directions; posterior slits 11; intermediate valves with one slit, jugal area minutely decussated, almost carinate; lateral areas with usually three corrugated ribs, the nodulation of the posterior rib undulating the margin of the valve, but there may be one or two minor intercalary ribs; the pleural areas are axially ribbed with deep decussated interspaces, the ribs growing stronger as they recede from the jugal region; interior pink, the jugal sinus hardly marked, axially striated, merging laterally into narrow sutural laminæ. Length of shell, 11; width, 7; height, 2.5 mm.

Habitat.—Pacific Grove, Monterey Bay, California. Cat. No. 193375, U.S.N.M.

This is one of Dr. Paul Bartsch's undescribed species.

ISCHNOCHITON (STENOPLAX) AETHONUS, new species.

Chiton narrow and elongate, of deep rose pink, with or without whitish mottling along the dorsal ridge, which is evenly rounded; girdle brownish, covered with a dense coating of short, even, minute spinules of a grayish-white color, giving a smooth arenaceous surface; anterior valve more than semicircular, sculptured with equal, regularly spaced concentric fine threads with wider interspaces and covered by a microscopic decussation which is found over the whole surface of the valves; anterior slits 11 or 12; posterior valve with a low, nearly smooth mucro, slightly in advance of the center and uniform concentric sculpture, as in the anterior valve; there is no defined central area; posterior slits 10 or 11; intermediate valves with one slit at each end, the lateral areas slightly convex but not sharply delimited, with the jugal and pleural tracts not separated or limited, the sculpture the same as on the other valves, but the concentric threads slightly wavy; interior pink, the jugal sinus very shallow, wide, indicated by a small notch at each end, straight edged, smooth; the sutural laminae narrow, elongated; length of shell, 11; width, 6.5; height, 4 mm.

Habitat.—Near Cape San Lucas, Lower California, in 10 fathoms. Cat. No. 218814, U.S.N.M.

This is of the same general type as *I. limaciformis*, but has a sculpture totally different from that of that species or *I. fallax*.

ISCHNOCHITON COOPERI ACUTIOR Carpenter, MS.

On comparing specimens named by Carpenter in the collection of the United States National Museum, the only differences I could perceive were that the specimens of the variety *acutior* were lighter and brighter in color, more emphatic in sculpture, and apparently younger shells. In a group where color is often without systematic value, these differences seem hardly worthy of a name, analogous mutations being most common among Chitons.

ISCHNOCHITON (RADSIELLA) AETHALOTUS, new species.

Chiton small, flattish, wide, both valves and girdle of an olivaceous tint, the latter densely covered with small oval imbricating scales; anterior valve with about 18 irregularly spaced slits, less than semicircular, sculptured with fine, close, minutely divaricating incised lines, among which are sparsely scattered relatively large brownish (ocular ?) pustules; this sculpture is extended over the whole surface of all the valves, the pustules showing no regularity, except a somewhat radial arrangement on the posterior valve; there is no segregated jugal tract and the lateral areas are feebly indicated; posterior valve with 11 slits, the mucro very obscure, subcentral, the insertion plates smooth, the sutural laminae small, the jugal sinus shallow, straight-edged, smooth inside; intermediate valves with 2 slits, the first valve axially wider than the second, all with the jugal sinus not defined; the sutural laminae rather wide, the valves not mucronate; interior color greenish; gill rows ambient. Length, 12; width, 6; height; 2 mm.

Habitat.—Gulf of California, W. J. Fisher. Cat. No. 58806*c*, U.S.N.M.

The absolutely irregular distribution of the brown pustules if characteristic of the species is quite remarkable. They are not polished.

ISCHNOCHITON EUCOSMIUS, new species.

Chiton small, back high but rounded, surface without eyespots; the surface variegated with white and sage-green with a tendency to white spots on the posterior edge of the intermediate valves as in *C. dentiens*, the interior apple-green; anterior valve with 10 slits, somewhat more than semicircular, obliquely decussated with extremely fine striae, which on the intermediate valves give an effect of divarication, this sort of sculpture covers the whole shell; posterior valve with 9 slits, and a low blunt mucro in front of which the valve is depressed; girdle white or maculated with white and gray, covered densely with flattish lozenge-shaped, pavement-like scales; intermediate valves with 1 slit at each end, the lateral areas feebly marked without distinctive sculpture, the sutural laminae narrow, the jugal sinus very shallow, defined by a slight notch at each end. Length, 10; width, 5.5; height, 3.3 mm.

Habitat.—Magdalena Bay, Lower California, C. R. Orcutt. Cat. No. 218194, U.S.N.M.

The coloration of the specimens in hand is especially neat, though doubtless in a large number the variations would be extreme.

ISCHNOCHITON VENEZIUS, new species.

Chiton small, warm yellow-brown with a whitish "bloom," the girdle mottled with brown and white, covered with a pavement-like coating of minute rounded scales; anterior valve with 14; posterior with 12; and the intermediate valves with 1 slit at each end; anterior valve nearly semicircular, with over 20 radial rows of small pustules, for the rest covered with a very minute oblique decussation; posterior valve smaller, with mucro low and slightly behind the center, the posterior tract decussated minutely and with a few scattered pustules near the margin, the central area reticulate; intermediate valves mucronate, minutely decussate; pleural tracts with fine low axial threading and punctate interspaces; lateral areas with 2 or 3 somewhat irregular radial rows of pustules on a minutely decussated ground. Length, 7; width, 3.5; height, 2 mm.

Habitat.—Near Venice, Los Angeles County, California, University of Southern California. Cat. No. 216792, U.S.N.M.

This is one of the most elegant of the smaller species of the coast. The jugal sinus is straight edged and the sutural laminae narrow.

? CHAETOPLEURA LACTICA, new species.

Chiton small, cream-colored, often maculated with pale green, with high almost carinate back, the girdle spongy with a few small spinules and sparse hairs on a leathery basis; anterior valve with 8 or 9 slits, posterior with 2 slits, intermediate valves with single slits; anterior valve with about 10 feeble radii, otherwise minutely punctate-reticulate; posterior valve small, with subcentral mucro and similar sculpture; intermediate valves with the jugal and pleural tracts not separated, mucronate, sculptured with obliquely axial very fine threads with punctate interspaces; the lateral areas bounded by a slender, sometimes beaded rib in front and a marginal thickening behind, otherwise sculptured like the rest of the valve; internally whitish with a wide and shallow jugal sinus and prominent sutural laminae. Length, 8; width, 4.5; height, 2 mm.

Habitat.—Catalina Harbor, California, W. H. Dall. Cat. No. 172900, U.S.N.M.

CALLISTOCHITON ACINATUS, new species.

Chiton small, yellowish white, strongly sculptured; the anterior valve with nine nodulous ribs with narrower interspaces, a minutely granulose surface and about 12 inconspicuous slits; posterior valve with 18 slits and 6 nodular ribs; this valve is much smaller, the central tract is narrow and coarsely reticulate; intermediate valves somewhat mucronate with 1 slit at each end; the sculpture on the lateral areas consists distally of two very prominently pustulate ribs, toward the dorsal ridge there are only crowded minor pustules; the jugal and pleural tracts are coarsely reticulate, the interspaces deep; the girdle yellowish with densely crowded microscopic imbricating scales; length, 6; breadth, 3; height, 1.5 mm.

Habitat.—Shore at San Pedro, California. Cat. No. 218773, U.S.N.M.

Though very minute, this does not seem to fit in with the adult of any of the other species.

CALLISTOCHITON CELETUS, new species.

Chiton of moderate size, pale brownish, with a mottled white and brownish girdle scaled like the preceding species; anterior valve with 11 nodulous ribs, which, except the closer set posterior pairs, have about equal interspaces; this valve has 9 slits, each corresponding to a rib, the posterior valve has 24, but only 6 ribs which are mostly split for a short distance distally; this valve is conspicuously convex, with about 6 large smooth nodules to each rib, the central tract is narrow and coarsely axially threaded; in the intermediate valves with 1 slit at each end, the lateral areas comprise two strong ribs with vertically compressed nodules, 8 or 9 to a rib, there is a very narrow smooth spot on the hardly mucronate jugum, the pleural tracts have near the jugal area 6 or 7 close-set axial threads and beyond them about the same number of sharp straight axial threads with wider interspaces crossed by much finer, closer, transverse threadlets; internally the valves are whitish and the sutural laminae appear to join each other in front of the obsolete jugal sinus. Length, 10; width, 6, height, 2 mm.

Habitat.—Shore at San Pedro, California. Cat. No. 218770, U.S.N.M.

CALLISTOCHITON AEPYNOTUS, new species.

Chiton yellowish white, with a keeled back, the girdle as usual in the group; anterior valve with 10 annulate ribs and a slit for each rib; posterior valve small, low, with only about 5 feeble ribs, and 5 slits, the central area reticulate; intermediate valves with a narrow smooth line at the jugum, and single slits; the pleural tracts sharply obliquely reticulate with deep interspaces; the lateral areas bounded by 2 strong annulate ribs, the posterior rib wider, the interspaces regularly punctate-reticulate; interior white, the jugal sinus almost obsolete. Length, 15; width, 7; height, 5 mm.

Habitat.—Puget sound, in 37 fathoms rocky bottom, temperature 46°. United States Fish Commission. Cat. No. 225448, U.S.N.M.

One of the specimens has the distal nodule of a black color on each rib, all round the border.

CALLISTOCHITON CYANOSUS, new species.

Chiton of moderate size, rounded back, and rather low dorsum, the color pale blue with interrupted bands of straw-color, the girdle armature as usual, but rather finer and pale in color; anterior valve with 11 keeled ribs, a slit to 9 of them; these ribs are crossed by fine concentric threads with about equal, not punctate, interspaces; posterior valve low, with subcentral mucro similarly sculptured, the central area rather larger than the ribbed portion with 10 or 11 prominent axial threads on each side, the interspaces crossed by similar threads, making a conspicuous reticulation; in the posterior portion are 8 carinate ribs each with a slit; the intermediate valves with one slit on each end, the lateral areas bounded by 2 strong keeled ribs crossed by small equal threads, not punctate in the interspaces, denticulating the posterior edge of the area; jugal areas showing a narrow triangular smooth space, on each side of which are 15 or more strong straight axial threads, the subequal interspaces reticulated by smaller threads and the interstices deep; interior bluish white with a wide straight-edged jugal sinus and rather broad sutural laminae. Length, 13; width, 8; height, 3 mm.

Habitat.—Long Beach, San Pedro, California, Mrs. Hartwell. Cat. No. 109317, U.S.N.M.

This has somewhat the characters of *Ischnochiton*, toward which it makes a partial approach.

CALLISTOCHITON CHTHONIUS, new species.

Chiton of moderate size and dark reddish brown color, including the girdle which exhibits small lozenge-shaped imbricating scales uniform over the surface; anterior valve with 11 subcarinate radial ribs, the two posterior tending to bifurcate, and nine slits; the ribs are hardly nodulous, and in the type the interspaces are reticulated only on the left side of the axis; posterior valve with 13 slits, nine nodulous riblets, the mucro subcentral, the central area axially threaded with a median smooth keel; intermediate valves with a smooth narrow keel at the jugum, the pleural tracts with a strong rectangular reticulation; the lateral areas with two strong keeled ribs, the posterior rib bifurcate for most of its length and the distal ends sometimes divided; these ribs are more or less nodulous, denticulating the posterior edge of the valve; the interspace between the main ribs is deep and angular; the insertion plates have a single slit; the interior of the posterior valve in dark green, of the other valves greenish white; the jugal sinus is very shallow, straight edged and wide, the sutural laminae rather narrow. Length, 21.5; width, 10; height, 5 mm.

Habitat.—San Pedro, California. Cat. No. 109488, U.S.N.M.

This is another species which verges toward *Ischnochiton.*

CALLISTOCHITON FISHERI, new species.

Chiton light greenish gray, small, strongly sculptured, the girdle covered with minute closely crowded gray scales giving a velvety aspect; anterior valve with 12 strong annulate radial ribs with narrower interspaces, internally with 11 slits; posterior valve with the mucro behind the center, the central area coarsely irregularly reticulate, the posterior area elevated, with six strong annulate ribs, a slit to each rib, a roundly excavated jugal sinus and narrow rectangular sutural laminae; the interior is dark green; intermediate valves with one feeble slit at each end, excavate rather than mucronate at the jugal area which is obliquely reticulate, passing into the pleural tracts which are small, axially threaded, the interstices with minute transverse threads; lateral areas with two annulate ribs, the posterior stronger, denticulating the posterior edge of the valve; internally pale greenish with a wide shallow straight edged jugal sinus and narrow sutural laminae. Length, 10; width, 5; height, 3 mm.

Habitat.—Glory of Russia Bay, Tanaga Island, Aleutians, on a sponge thrown up by the surf; W. J. Fisher. Cat. No. 110353, U.S.N.M.

CALLISTOCHITON DUNCANUS, new species.

Chiton small, yellowish white, strongly sculptured, with a velvety girdle densely covered with minute whitish spinules, fringed a little at the outer margin; anterior valve with nine strong annulate ribs with subequal interspaces and seven slits; posterior valve with subcentral mucro, the central area axially threaded, the posterior tract with six slightly elevated ribs, the anterior pair bifurcate, internally with seven slits, the sinus shallow and rounded, the sutural laminae rather wide and not rounded; intermediate valves slightly mucronate, the jugal area axially striate and rounded, the pleural tracts axially threaded with transverse minuter threads in the interspaces, the lateral areas very narrow with two strong nodulous ribs (sometimes bifurcate) and the posterior margin minutely denticulate: Length, 10; width, 4.5; height, 2.2 mm.

Habitat.—Duncan Island, Galapagos Islands, United States Fish Commission steamer *Albatross*. Cat. No. 218772 U.S.N.M.

MOPALIA CHLORIS, new species.

Chiton low, wide, of moderate size, of a dark bronze green, with leathery girdle which when fresh had a few slender, sparsely distributed hairs upon it (lost in the dry specimen); anterior valve with eight slits, externally with about ten radiating conspicuous threads with a few feebler shorter intercalary threads, over the whole of which is a faint very minute oblique decussation; posterior valve small, with a very low subcentral mucro and a faint concave wave medially behind, over which is a white ray; it has two slits and a narrow rounded jugal sinus with wide sutural laminae, the finer sculpture is like that of the anterior valve with one or two radial threads; intermediate valves with one slit, the jugal tract acute, with the pleural tract sculptured with oval punctures between oblique almost obsolete minute threads; the lateral areas defined by a single cord, otherwise similarly sculptured; interior bluish-white, the jugal sinus narrow, rounded, the sutural laminae broad, the insertion plates smooth; gill rows ambient. Length, 19; width, 11; height, 3 mm.

Habitat.—San Diego, California; Mrs. N. Davie. Cat. No. 293686 U.S.N.M.

This at first sight recalls *M. hindsii* or *lignosa* but the sculpture is quite different.

MOPALIA GONIURA, new species.

Chiton of small size with a high arched back, of a yellowish color flecked with scarlet; the girdle red, velvety, with numerous sparsely scattered large brown spines (broken off in the type) chiefly near the inner border, and smaller ones scattered near the outer part; gill rows about two-thirds the length of the foot; anterior valve with 8 slits, posterior with 4, intermediate valves with single slits; anterior valve with 10 radii, the two marginal wider, otherwise the surface is covered with punctate reticulation; posterior valve small, the mucro at the posterior third, sculpture of the posterior tract in radial lines of pustules, the central area has very similar ornamentation; the posterior sinus is narrow Λ-shaped, the apex reaching the mucro, the anterior sinus also narrow and acute, the sutural laminae broad; jugal and pleural areas of the intermediate valves not separated, the sculpture of oblique reticulation with emphatically punctate interstices; lateral areas similarly sculptured, bounded on each side by a slender rib, internally whitish with a narrow notch-like sinus. Length, 12; width, 6; height, 4 mm.

Habitat.—Granite Cove, Port Althorp, Alaska, in 16 fathoms, gravel, collected by W. H. Dall. Cat. No. 208703, U.S.N.M.

None other of the northern species has such a deep angular posterior sinus.

MOPALIA CELETOIDES, new species.

Chiton with sculpture almost exactly like No. 218770, except that the latter has more globular nodules on the lateral ribs and the pleural tracts are less coarsely and evenly reticulated. In the present species the anterior valve has 10 radial ribs with wider channeled interspaces minutely reticulated; the posterior valve, however, entirely different, having a posterior mucro with a small rounded sinus below it, and no ribs, the surface being taken up by the central area which has very straight axial threads minutely annulated, with much finer and closer transverse threads visible in the interspaces; gillrows extending forward as far as the fourth valve; posterior valve with 2 slits, anterior with 8, intermediate with one at each end; intermediate valves with the lateral areas bounded by two strong ribs, the posterior wider, denticulating the posterior margin; the interspaces minutely reticulated; jugum minute with a small smooth mucro, the back slightly keeled in front of it, the pleural tracts with about 11 strong axial threads with wider interspaces crossed by regular equal minute threads. Length, 12; width, 5.5; height, 2.5 mm.

Habitat.—Forrester Island, Alaska; G. Willett. Cat. No. 218771, U.S.N.M.

This at first glance looks very unlike a *Mopalia*. Compare *Callistochiton celetus*.

SEMIMOPALIA, new subgenus.

Anterior valves slit, posterior valves with entire insertion plates.

MOPALIA (SEMIMOPALIA) GRISEA, new species.

Chiton of moderate size with pale olive-gray valves streaked with a darker shade and with a series of pale rays on the dorsal line; girdle leathery with sparse, rather long, often duplex hairs; anterior valve with 7 or 8 slits, posterior valve with no slits, anterior four intermediate valves with one slit and the fifth and sixth without slits, the insertion plates smooth; anterior valve with 11 or 12 radii, the surface minutely decussate; posterior valve much smaller with a feeble posterior sinus, the low mucro at the posterior fourth, the surface microscopically decussate without other sculpture; internally greenish, with a rather narrow jugal sinus and prominent sutural laminae; intermediate valves polished, slightly mucronate, wholly microscopically decussate, without other sculpture except two slender simple ribs which border the lateral areas; internally greenish and white with wide and shallow jugal sinus and narrow arcuate sutural laminae. Length, 20; width, 11; height, 3 mm.

Habitat.—Between Cape Pillar and Cape Horn, Tierra del Fuego; Stokes. Cat. No. 218734, U.S.N.M.

In spite of its gloomy color this is a very elegant species.

ACANTHOCHITONA ANGELICA, new species.

Since the sculpture of all the species from the west coast is so very similar this form perhaps may be best indicated by comparison with the other known species. The valves are of a bright scarlet and mucronate; the tufts of bristles are white and only moderately profuse, the girdle otherwise is covered with short grayish spines of irregular length and plushlike aspect.

From *A. avicula* Carpenter, it is distinguished by its more central mucro in the posterior valve, its generally larger valves and narrower girdle. Nearly the same differences separate it from *A. diegensis* Pilsbry, and *aragonites* Carpenter. It has not the profuse silky bristles of Pilsbry's *A. exquisita*, nor the broad girdle and peculiar sculpture of Sowerby's *A. hirundiniformis*. None of these species has the intermediate valves so long axially in proportion to their transverse width. The form of the valves is almost semicircular, the jugal area axially striated and the remainder of the exposed surface has the scaly sculpture usual in this genus. Length, about 11; width, 5; height, 3 mm.

Habitat.—Angeles Bay, Gulf of California, W. J. Fisher. Cat. No. 110346, U.S.N.M.

TONICIA MIXTA, new species.

Chiton of moderate size, mottled or streaked with light brown, scarlet, gray, blackish and white, the back rounded, the valves mucronate but not keeled, the gill rows ambient, the girdle with a dense coating of short spinules with a few scattered longer spines; anterior valve with 8 or 9 slits, posterior with 11 or 12, intermediate valves with one or two, sometimes differing on opposite ends of the same valve, the insertion plates striated; anterior valve small, semicircular, more or less densely provided with small pustules and irregularly distributed polished brown eyespots; there are faint indications of five radial threads which in some individuals might become stronger; the surface of the whole shell is covered with microscopic punctation; posterior valve with low central or post central mucro, the central area with coarse axial nodulous threads, the posterior tract pustulose; interior whitish with small narrow straight-edged jugal sinus, and rather wide arcuate sutural laminae; intermediate valves with the first axially wider than the rest, the jugal area wide, axially sculptured with interrupted axial threads or rows of elongated pustules, the lateral areas ill defined, with only very few irregularly scattered prominent pustules, more abundant in some specimens; internally whitish or pale greenish; the jugal sinus narrow, the margin in all the valves projecting tongue-like; the sutural laminae arcuate. Length, 16; width, 8; height, 4 mm.

Habitat.—Angeles Bay, Gulf of California, W. J. Fisher. Cat. No. 110345, U.S.N.M.

This belongs to the same group as *T. pustulifera*, to which it is nearly allied but separated by sufficient characters. The projection of the margin of the jugal sinus is most prominent in the seventh valve, but is found in all the intermediate valves. The inner surface of this feature is smooth. The coating of the girdle is less leathery than in the more southern Tonicias, but under the microscope even they show minute spinules more or less abundant.

TONICIA PUSTULIFERA, new species.

Chiton of moderate size, polished, yellowish mottled with dark green, dark brown and brown dots, the back rounded, the girdle yellowish, densely covered with minute short spinules giving a velvety aspect and with no fringe of longer spines at the border; anterior valve with 8, posterior with 11, intermediate valves with single slits, the insertion plates minutely radially striated; anterior valve more than semicircular with a profusion of minute pustules corresponding to sense organs and leaving a puncture when worn off; otherwise smooth; posterior valve smaller with the mucro much in front of the center, the central area narrow, sculpture as in the anterior valve, internally with a pink spot, the jugal sinus small and shallow, the sutural laminae long and narrow; intermediate valves with the first axially longer than the others, the valves slightly mucronate, the jugal area narrow and smooth except on the first valve which has a few axial grooves, the pleural tracts smooth except for a few very feeble wavy subaxial threads often obsolete on one side of the same valve, stronger near the jugum and on the posterior valves, and a few scattered very minute pustules; there are faint traces in spots, of a microscopic decussation; lateral areas without ribs, feebly indicated, bearing oblique rows of minute pustules; internally white, pinkish under the jugum, the jugal sinus narrow, deep, straight edged, the sutural laminae broad, arcuate; the gill rows ambient. Length about 19; width, 10; height, 5 mm.

Habitat.—San Pedro, California. Cat. No. 218736, U.S.N.M.

DESCRIPTIONS OF NEW NORTH AMERICAN ICHNEUMON-FLIES.

By R. A. Cushman.
Bureau of Entomology, United States Department of Agriculture.

This paper consists of the descriptions of a new tribe, two new genera, and fourteen new species of ichneumon-flies, together with observations on other forms in the United States National Museum collection.

Family BRACONIDAE.

HABROBRACON POLITIVENTRIS, new species.

In my key to the North American species of *Habrobracon*[1] this species runs to couplet 3, but agrees with neither alternative. From all of the species falling under the characters there given it differs in having the abdomen highly polished. The furrows of the first tergite are crenulate, the triangular area is not punctate at apex, the lateral areas are polished and almost without sculpture. The second tergite is polished and without sculpture, except in the broad, reticulate impressions setting off the embossed area.

Female.—Length, 2.25 mm. Face, frons, and vertex shagreened; head behind eyes and ocelli polished, with large, scattered, shallow punctures; antennae 24 jointed, rather long and slender, the flagellar joints much longer than thick; thorax polished, with indistinct, sparse punctures; propodeum polished, faintly shagreened; second abscissa of radius slightly longer than first intercubitus; abdomen highly polished with lateral areas of first tergite slightly roughened; grooves of first tergite finely crenulate; embossed area of second tergite not especially developed but set off anteriorly by broad, oblique crenulate impressions; ovipositor very short.

Black; mouth, and inner orbits, the latter including the area about the base of the antennae, and lateral margins of abdomen, yellowish; femora and trochanters yellowish-testaceous; coxae, tibiae, and tarsi more or less blackish, those of hind legs darkest; wings dusky basally, hyaline apically.

Host.—Polychrosis viteana Clemons.

Type-locality.—North East, Pennsylvania.

Type.—Cat. No. 21639, U.S.N.M.

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[1] Proc. Ent. Soc. Wash., vol. 16, 1914, p. 100.

Described from three females reared by the writer as parasites of the larva of the grape-berry moth. The paratypes are like the type, except that *b* has the notauli very faintly marked anteriorly with reddish.

Family ICHNEUMONIDAE.

Subfamily Cryptinae.

Many of the genera proposed by Foerster in his classification of the Ichneumonidae were described only by the characters given in the keys and were not fixed by the designation of genotype or the inclusion of any species. Since their original publication many of these genera have had species included, some probably with entire propriety and others by obvious error. In cases where species are the first included in previously atypic genera they become *ipso facto* the genotypes of those genera. But, according to Opinion 46 of the International Commission on Zoological Nomenclature, they can not be the genotypes unless they come under the generic descriptions as originally published. Apparently the only recourse in a case where the first included species does not agree with the original publication of the genus is to consider the genus, as defined by the first included species, as dating from the inclusion of the species and having as its author the author of the species and the generic name as being preoccupied. It thus becomes a homonym and must be reduced to synonymy with the genus with which it does agree, if such is already named, or be given a new name.

To this class belong the genera *Otacustes* and *Lymeon* both of Ashmead, not of Foerster. These genera are below disposed of as outlined above.

Genus CHRYSOPOCTONUS, new name.

Otacustes Ashmead, Ins. Life, vol. 7, 1894, p. 244, not Foerster.

Type.—Otacustes atriceps Ashmead.

The genotype, which was also the first species included in *Otacustes*, does not agree with the original description of *Otacustes* Foerster in that the spiracle is round, not oval. In Foerster's key to his family Hemiteloidae (=Tribe Hemitelini Ashmead) it runs to dichotomy 49. In the best of the characters used, namely, the relative length of the basal joints of the flagellum and the length of the radial cell as compared with that of the stigma, it agrees with *Microtorus* Foerster, but differs in having the dorsal carinae of the petiole weak and the ten flagellar joints before the last in the female longer than broad.

Couplet 49 should, therefore, be changed to read thus:

49. Flagellum filiform, thickened toward the apex, the first three joints much lengthened, thin, and of equal length; radial cell longer than the stigma; dorsal carinae of first tergite extending to the middle but weak.
Orthizema Foerster.

First flagellar joint somewhat longer than second, this distinctly longer than third; radial cell not longer than stigma.

Dorsal carinae of first tergite extending sharply and distinctly to beyond the middle; the ten joints of the flagellum before the last broader than long..*Microtorus* Foerster.

Dorsal carinae of first tergite not especially sharp and distinct; ten flagellar joints before the last longer than broad.

Chrysopoctonus, new name, for *Otacustes* Ashmead, not Foerster.

It is doubtful if either of the two characters separating the last two genera is of generic value, but all of the three species of *Chrysopoctonus* represented by females in the United States National Musuem agree in both characters although there is some variation in the strength of the petiolar carinae.

The species of this genus may be congeneric with the species on which Foerster based his description of *Microtorus*, but neither of the species here included can be the genotype of *Microtorus* because they all differ by the two characters used in the above key.

Other characters of the genus in addition to those above and those in Foerster's key are as follows:

Head from above very broad, the temples flat or weakly convex and very strongly receding, occipital carina complete, not angulate medially, ocellar triangle very strongly transverse, the anterior ocellus but little in front of the lateral ocelli; head in front view much broader than long, face and frons very broad, eyes very large and nearly hemispherical, clypeus much broader than long, distinctly separated, broadly arcuate at apex, not or but very weakly medially impressed, without long hairs, flagellum somewhat thickened toward apex, first three joints successively shorter, subapical joints slightly longer than wide; fourth joint of maxillary palpi fully three-fourths as long as fifth. Thorax very short and thick, mesoscutum fully as broad as long, notauli very briefly impressed, sternauli complete or nearly; prepectal carina complete and strong throughout, scutellum laterally carinate well beyond base; propodeum nearly perpendicular behind, completely areolated, the areola broader than long, spiracle round, situated very close to lateral carina, legs long and stout, hind femur reaching nearly to apex of abdomen, inner spur of hind tibia nearly half as long as basitarsus; stigma broad with radius originating beyond middle, radial cell short, measured on metacarpus as long as stigma, second intercubitus not or barely indicated, venation otherwise complete, nervellus broken below the middle, second and third abscissae of discoideus together about equal in length to the first abscissa, second discoidal cell not especially narrowed at base. Abdomen relatively small, first tergite broad at apex, spiracles much beyond middle, dorsal carinae rather weak, rest of abdomen broadly oval, strongly depressed, segments beyond fifth in female not or scarcely visible from above, ovipositor not or but little longer than first tergite.

All of the species known are parasitic in the cocoons of Chrysopidae and Hemerobiidae.

In North America the genus is represented in addition to the genotype by (*Otacustes*) *Chrysopoctonus chrysopae* (Ashmead), (*Hemiteles*) *Chrysopoctonus rileyi* (Ashmead), and the new species described below.

(HEMITELES) CHRYSOPOCTONUS RILEYI (Ashmead).

(*Hemiteles*) *Chrysopoctonus rileyi* ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 402, male.

Hemiteles hemerobii ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 404, male.

Hemiteles euryptychiae ASHMEAD, Trans, Amer. Ent. Soc., vol. 23, 1896, p. 210, female.

Otacustes cressoniformis VIERECK, Conn. State Geol. & Nat. Hist. Survey, Bull. 22, pt. 3, Hym. Conn., 1916, pp. 339, 340, female.

The types of *rileyi*, *hemerobii*, and *euryptychiae* and a metatype of *cressoniformis* are in the United States National Museum, and have been studied in connection with other material. A series of four specimens, three males and one female, reared by the writer from cocoons of *Chrysopa* at North East, Pennsylvania, shows the entirely black thorax of the male and the partially red thorax of the female and the differently colored coxae to be sexual differences.

The exserted portion of the ovipositor is only about half as long as the abdomen instead of as long as the abdomen, as stated by Viereck. The scutellum in the female varies from all red to all black; and the abdomen has the first three tergites from entirely red to more than half black, the basal tergite being sometimes entirely black. The darker specimens are from more northern localities. The type of *euryptychiae* purports to have been reared from (*Euryptychia saligneana* Clemons) = *Eucosma scudderiana* Clemons, but it probably came from the cocoon of a *Chrysopa* or a *Hemerobius* which crawled into the *Eucosma* gall for pupation.

CHRYSOPOCTONUS PATRUELIS, new species.

Very closely allied to *rileyi* (Ashmead) and differing principally as follows:

Female.—Length, 4 mm.; antennae, 3 mm.; ovipositor, 0.8 mm. Temples nearly flat; postocellar line nearly twice as long as ocellocular line; punctuation stronger and more dense, more conspicuously so on postpetiole, which in *rileyi* is impunctate to weakly, sparsely punctate.

Black with entire prothorax and mesopleura, except prepectus, rufous (in *rileyi* the ventral area between the sternauli is black); red color of abdomen confined largely to the base of the second tergite, the tergites beyond the first being also very narrowly tipped with red; legs rufo-testaceous, the hind coxae and trochanters above, the femora at apex, and the tibiae and tarsi entirely infuscate; clypeus and mandibles dark rufous; palpi yellowish testaceous; antennae beneath at base rufous (in *rileyi* the appendages are uniformly lighter in color).

Male.—Differs from the female in having the posterior ocelli even farther apart; thorax black, the front and middle coxae and trochanters white, hind legs darker, the coxae and trochanters black, otherwise piceous; antennae black, only the scape red beneath; second and third tergites basally reddish and the apical bands more conspicuous.

Type-host.—*Chrysopa*, species.

Type-locality.—Alhambra, California.

Other localities.—Pasadena and Monrovia, California.

Type.—Cat. No. 21645, U.S.N.M.

Described from five females and three males, all reared by Mr. R. S. Woglum, of the Bureau of Entomology, in connection with his work on *Pseudococcus citri.*

The female paratypes display a considerable degree of variation in color from the type, paratypes *c* and *d* having the mesoscutum, except a quadrate spot in front of the scutellum, the scutellum, and the metapleura red and the legs paler. Both of the male paratypes have the hind femora more reddish.

Genus CRYPTUROPSIS Ashmead.

Lymeon ASHMEAD, Ins. Life, vol. 7, 1894, p. 243, not Foerster.

Ashmead's *Lymeon* as characterized by the only included species, *Lymeon annulicornis* Ashmead, can not be the same as Foerster's, for it is not Hemiteline but Mesostenine, having the characteristic venation of the latter tribe. In Ashmead's key to the Mesostenini it runs directly to *Crypturopsis* Ashmead, with the genotype of which it is congeneric. *Lymeon annulicornis* is very closely related to, if not synonymous with, (*Mesostenus*) *Crypturopsis diligens* (Cresson) judging from the description of that species. The open areolet is apparently what led Ashmead to place this species in the Hemitelini. The extremely long legs ascribed to *Crypturopsis* is largely a male sexual character, and applies almost equally as well to the males in some of the other genera tabulated by Ashmead.

Genus MYERSIA Viereck.

This genus, for which Viereck erected his family Myersiidae, is apparently nothing more than a distinct genus in the tribe Stilpnini. In general form it is extremely like the typical genus, *Stilpnus*. Its completely fused second and third tergites, which are separated only by the merest trace of the suture distinguishes it from all of the genera placed in the Stilpnini by Foerster and by Schmiedeknecht. In the keys of both writers it runs best to *Xestophya* Foerster because of the lack of the second intercubitus. In ***Myersia***, however, the aerolet may almost be said to be entirely lacking, the very short intercubitus and nearly straight apical abscissa of the cubitus barely defining it.

From Foerster's description of Xestophya[1] it differs principally as follows: Head transverse, rather strongly narrowed behind the eyes; clypeus more or less distinctly separated, especially laterally, where it is flanked by very deep, round fossae; malar space with a band of fine sculpture separating the face from the cheeks; postocellar and ocell-ocular lines subequal; antennae in female 18-jointed; notauli deep anteriorly, fading out posteriorly; prepectal carina ("die vorne aufsteigende Brustleiste" of Foerster) oblique and joining the promesothoracic suture somewhat below the middle; the middle lateral and middle pleural areas of the propodeum separated by a strong carina; first tergite longer than the combined hind coxa and trochanter, the postpetiole much wider at apex than the petiole; second and third tergites completely fused, the only trace of the suture being a short groove at each side, these two tergites occupying nearly the entire dorsal and lateral surfaces and overlapping below, the third, as seen from above, not much broader than long; ovipositor distinctly exserted; hind tibiae not swollen, the longer spur reaching nearly to the middle of the metatarsus, last tarsal joint as long as third; stigma very narrow, the radius originating in the middle, second abscissa forming with the first a right angle.

MYERSIA PALLIDA, new species.

Immediately distinguishable from the genotype and only described species *laminata* Viereck by its pale ferruginous color.

Female.—Length, 4 mm.; antennae, 3 mm.

Head in front view nearly as long as wide, subtriangular, face finely, irregularly, transversely striate, subpolished and lightly shagreened at sides, the latter sculpture extending to the frons and vertex, temples convexly sloping, polished; clypeus sharply separated except narrowly at middle, opaque, coarsely, sparsely punctate, as are also the mandibles; face, clypeus, and mandibles with long, coarse, erect hairs, longest on the clypeus; malar space fully a half longer than basal width of mandible; mesoscutum and sctellum finely shagreened, with indistinct, sparse punctures; pronotum shagreened, striately so below; mesopleura longitudinally striate, the sternauli roadly impressed; metapleura finely opaque above, strongly, irregularly rugose below; propodeum with carinae strong, subpolished, lightly coriaceous; apical abscissa of radius sinuate, nervulus slightly postfurcal, nervellus straight, unbroken; first tergite longitudinally striate, polished at apex, the dorsal carinae fading out beyond the spiracles; rest of abdomen highly polished; exserted portion of ovipositor about three-fifths as long as first tergite.

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[1] ynoptische Übersicht der Gattungen und Arten in der Familie der Stilpniden, 1876,

Pale ferruginous, with abdomen gradually darkening to fuscous toward apex, postpetiole narrowly outlined with brown; legs nearly uniform flavous, antennae flavous at base gradually darkening to pale brownish toward apex, wings hyaline with veins and stigma pale brownish.

Type-locality.—Fort George, Florida.

Type.—Cat. No. 21633, U.S.N.M.

Described from one female.

Genus THAUMATOTYPIDEA Viereck.

In spite of its strong superficial resemblance to *Pezomachus* this genus is, in head, abdominal, and antennal characters, closely allied to *Myersia* Viereck, and should be referred to the Stilpnini, from all the other genera of which it is, of course, at once distinguished by its entire lack of wings in the female and the much modified thorax. The male is not known. The head is longer both antero-posteriorly and dorso-ventrally than that of *Myersia*, the clypeus is more distinctly separated with larger lateral fossae, the malar space longer, the first flagellar joint less distinctly longer than the second, the legs more slender with the hind tibial spurs very short, the first tergite more slender with the spiracles nearer the middle and the postpetiole not much wider than the petiole. The thorax is strongly constricted in the middle without a scutellum, the pronotum relatively large and mesoscutum much reduced, without notauli, the wings represented by tubercles, the propodeum separated from the metapleura by strong carinae and with a complete apical carina elevated laterally into strong spine-like projections. The abdomen is otherwise very like that of *Myesria* even to the short lateral traces of the suture between the second and third tergites and the briefly exserted ovipositor. The prepectal carina is like that of *Myersia.*

Genus THAUMATOTYPUS (Foerster) Brischke.

Judging from descriptions of this genus and its included species it should also be referred to the Stilpnini, the only marked difference between it and *Thaumatotypidea* Viereck being apparently in its possession of a scutellum.

Genus AENOPLEX (Foerster) Ashmead.

AENOPLEX POLYCHROSIDIS, new species.

In my key to the North American members of the genus[1] this species runs closest to *plesiotypus* Cushman, but is markedly distinct from that species in color. In this respect as well as in general habitus and length of ovipositor, it is much more like *carpocapsae* Cushman.

Female.—Length, 4.5 mm.; antennae, 3 mm.; ovipositor, 0.75 mm. Differs from *carpocapsae* Cushman principally as follows: Sculpture throughout much finer, that of head and mesoscutum opaque, granular rather than punctate; clypeus polished, impunctate; notauli weak; areola nearly twice as long as wide, but little wider behind, petiolar area slightly longer than wide; abdomen subopaque granular basally, polished apically; first tergite with distinct dorsal carinae extending beyond the middle; ovipositor about a third as long as abdomen.

Black, with three basal abdominal segments, legs entirely, and two basal segments of flagellum testaceous; mandibles, scape, pedicel, and third flagellar joint piceous; antennae otherwise black; palpi stramineous; tegulae whitish.

Male.—Length, 5 mm.; antennae, 3.5 mm. Differs from female in having the sculpture of thorax and abdomen stronger; notauli more distinct; flagellum entirely black, as is also the basal segment of the abdomen.

Host.—*Polychrosis viteana* Clemons.

Type-locality.—North East, Pennsylvania.

Type.—Cat. No. 21629, U.S.N.M.

Described from one pair reared April 11, 1917, in a greenhouse at Washington, District of Columbia, from cocoons of the host collected in October, 1916, at the type-locality.

(PHYGADEUON) AENOPLEX PHRYGANIDEAE (Ashmead).

A female and three males of this species have recently been received. These were all reared by F. B. Herbert, of the Bureau of Entomology, from the same host as the type material, *Phryganidea californica*, on which they were secondary through *Itoplectis behrensi* (Cresson). Examination of the host remains from which the type male was reared show it to have had the same relation to the *Phryganidea.* The new specimens were reared under Hopkins U. S. No. 14488 *g* and 14488 d^{1a}, at Palo Alto, California.

The following description is drawn from the types and the new specimens:

In my key to the species of *Aenoplex* runs on the subopaque, finely punctured mesoscutum to *nigrosoma* Cushman but differs in having the abdomen largely or entirely red, the ovipositor relatively shorter, and in having the apical carina of the propodeum practically mutic.

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[1] Proc. U. S. Nat. Mus., vol. 53, 1917, p. 458.

Female.—Length, 4.75 mm.; antennae, 3 mm.; ovipositor, 1.5 mm. Differs from *nigrosoma* Cushman otherwise principally as follows: Head not distinctly swollen; malar space about as long as basal width of mandible; antennae two-thirds as long as body, 25-jointed; propodeum transversely striate only behind, irregularly roughened above, the areola smooth, broader than long, hexagonal, petiolar area striato-granulate; inner spur of hind tibia more than a third as long as basitarsus; abdomen but slightly longer than head and thorax, two basal segments and third (basally) granular, otherwise polished; first tergite with dorsal carinae gradually weaker beyond middle and not reaching nearly to apex; ovipositor two-thirds as long as abdomen.

Black, with abdomen largely or wholly red; antennae reddish fuscous, usually paler at base; legs entirely rufo-testaceous, the hind tibiae and tarsi very slightly darkened; wings hyaline; tegulae stramineous; abdomen red, the petiole at extreme apex, and compressed portion laterally usually black. The type female has the abdomen and antennae entirely red.

Male.—Length, 4.75 mm.; antennae, 3.75 mm. Very like female, but with sculpture of thorax, propodeum, and abdomen stronger, first and second tergites distinctly striate, areola relatively narrower; abdomen with a greater extent of black both basally and apically, hind tibiae at apex, and their tarsi distinctly infuscate; antennae black, scape pale beneath.

(HEMITELES) AENOPLEX COMPACTUS (Ashmead).

Under the name *Hemiteles compactus* Cresson, Ashmead[1] included this species in a key to new species of the genus *Hemiteles.* This is the only published reference to the species except that in Dalla Torre's Catalogus Hymenopterorum, where it is accredited to Ashmead. The specimen on which Ashmead undoubtedly based his characterization of the species is in the United States National Museum. It is labeled in Cresson's hand "*compacta Cr.*" and in Ashmead's hand "*Hemiteles compactus Cr.*" This specimen, although not so labeled by Ashmead, must be considered the type of *compactus* Ashmead. The only description of the species consists in those characters in the key which apply to it. These are as follows: "Wings hyaline, body entirely black, antennae 24-jointed," the last undoubtedly variable.

The species should be referred to the genus *Aenoplex* rather than to *Hemiteles.*

The following description is based on the type and two other specimens:

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[1] Proc. U. S. Nat. Mus., vol. 12, 1890, p. 398.

Female.—Type.—Length, 7 mm.; antennae, 5 mm.; ovipositor, 2 mm.

In my key to the species of *Aenoplex*[1] it does not agree strictly with either alternate in the first couplet, the mesoscutum being opaque with dense minute punctures, especially in the posterior middle. It is, however, more closely allied to *Aenoplex nigrosoma* Cushman than to any of the other species, differing principally as follows: Stouter, head not distinctly swollen; temples more strongly rounded; malar space scarcely shorter than basal width of mandible; antennae relatively longer; propodeum hardly striate above, more irregularly roughened; areola much wider than long, about half as wide at base as at apex; inner spur of hind tibia less than one-third as long as basitarsus; abdomen but slightly longer than head and thorax; first tergite and second at anterior corners striate, abdomen otherwise sculptured as in *nigrosoma;* first tergite relatively broader, fully two-thirds as broad at apex as long; the spiracles prominent; evopositor little more than half as long as abdomen.

Black, and colored like *nigrosoma*, except that the antennae and entire hind tibia and tarsus are fuscous, the tegulae reddish, and the legs generally more yellowish than reddish.

Type.—Cat. No. 21630, U.S.N.M.

No locality.

A paratype female that lacks abdomen, wings, tips of antennae, and most of the legs agrees perfectly in head and thoracic characters with the type. The third specimen, reared from *Callosamia promethea* under Bureau of Entomology, No. 423 [1], differs from the type principally in having the legs and antennae darker and in having the areola distinctly emarginate behind.

Genus ISADELPHUS (Foerster) Roman.

Roman[2] synonymizes this genus with *Cecidonomus* Bridgman, and includes *inimicus* (Gravenhorst) and *nigriventris* (Thomson). The former was designated by Viereck[3] as the genotype of *Isadelphus.* According to the priority rule *Isadelphus* Foerster should have been used as the generic name. Viereck[3] synonymizes the two in the latter manner.

Specimens of *nigriventris* (Thomson) and *inimicus* (Gravenhorst) determined by Roman are in the United States National Museum collection. These specimens disagree somewhat with Foerster's characterization of the genus in that the middle lateral areas of the propodeum are not especially carinately prominent at the apex. In every other way, however, they do agree. The swollen head, apically compressed abdomen, and long ovipositor render the genus easily separable from the other genera of the Hemitelini. According to Roman the bidentate clypeus is not a character of generic importance, in which he is undoubtedly correct.

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[1] Proc. U. S. Nat. Mus., vol. 53, 1917, p. 459.

[2] Naturn. Untersuch. des Sarekgebriges, vol. 4, 1909, p. 233.

[3] Bull. 83, U. S. Nat. Mus., 1914, p. 76.

The following new species has the body and ovipositor even longer and more slender than usual, the antennae more slender with longer joints, the legs more slender, the clypeus without apical teeth, and the abdomen more strongly compressed than either of the species heretofore referred to the genus. In Ashmead's key it runs best to *Daictes* Foerster.

ISADELPHUS EXTENSOR, new species.

Female.—Length, 6.5 mm.; antennae, 5.5 mm.; ovipositor, 8 mm. Head and thorax clothed with very fine, short, appressed, cinereous pubescence, vertex and temples rather full, polished, obscurely, finely punctate; frons and face densely, finely punctate, pubescence of face longer and more dense; clypeus polished, narrowly subtruncate at apex with a narrow inflection at either side; antennae slender with the first two joints about five times as long as thick, the second slightly longer than first and the third shorter than the first; mesoscutum densely punctate medially, the prescutum and lateral lobes polished, weakly punctate, notauli sharply, though briefly impressed; scutellum sparsely punctate, polished; pronotum sparsely punctate, striate posteriorly; mesopleura obliquely striate, polished above; metapleura sparsely punctate, polished; propodeum cariaceous above, with a tendency to punctuation basally, polished, though slightly irregularly roughened behind, costulae present though very weak, other carinae laterad of the median carinae obsolete, areola hexagonal, about as broad as long, fully twice as wide at apex as at base; abdomen very slender, strongly compressed beyond second tergite; first three tergites granulate, others polished, first nearly twice as long as wide at apex, its sides slightly outwardly arcuate, without dorsal carinae, but with broad, weak ridges reaching to apex, spiracles only slightly beyond middle; hind tarsus distinctly longer than tibia, the basitarsus nearly as long as remaining joints combined, last joint but little longer than the fourth, the two combined barely longer than the third.

Black; antennae brownish towards apex; mandibles reddish; palpi fuscous; tegulae whitish; wing hyaline, veins and stigma brown; legs bright rufo-testaceous, hind tibiae at apex slightly and all tarsi infuscate.

Type-locality.—Palo Alto, California.

Type.—Cat. No. 21632, U.S.N.M.

Described from three females collected May 11, 1917, on *Quercus agrifolia* by F. B. Herbert.

The two paratypes are in every way typical.

Genus AMAUROMORPHA Ashmead.

Amauromorpha ASHMEAD, Proc. U. S. Nat. Mus., vol. 29, 1915, p. 410.
Eripternimorpha VIERECK, Proc. U. S. Nat. Mus., vol. 44, 1913, p. 645.

Comparison of the types of the genotypes of these two genera fails to disclose any generic difference. It is Cryptine rather than Ophionine as placed by Viereck and allied by its minute areolet to *Mesostenus* Gravenhorst.

Genus PANARGYROPS (Foerster) Schmiedeknecht.

In an earlier paper[1] I tabulated the North American species of *Bathythrix* (Foerster) Howard and described a new species under the name *B. tibialis*. Further study shows this to agree better with the present genus as represented by the genotype, *Panargyrops claviger* (Taschenberg). These two genera are placed in different tribes by practically all writers because of the fact that one has the areolet open and the other has it closed. It is my opinion that this character, far from being of tribal rank, is not even of generic value. Certainly the two genera under discussion are very closely related, surely as closely as subgenerically, the genotypes representing the extremes of variation within the genus. Thomson, who it seems to me, was one of the best interpreters of the value of characters, who has worked with Ichneumonidae, placed in his genus *Leptocryptus* (isogentopic with *Panargyrops*) species typical of both of Foerster's genera as represented by the genotypes, as well as some that run in Foerster's key to *Thysiotorus* and *Apsilops*, although not agreeing with the subsequently first included species of those genera.

The following new species is typical of the genus:

PANARGYROPS THORACICUS, new species.

Compared with (*Bathythrix*) *Panargyrops tibialis* (Cushman) differs as follows:

Female.—Length, 6 mm.; antennae, 4 mm.; ovipostor, 2.8 mm.

Malar space barely a third as long as basal width of mandible (this character is wrongly stated in the description of *tibialis;* it should read "malar space slightly less than half as long as basal width of mandible"); first tergite not distinctly wider at apex than at spiracles (in *tibialis* the postpetiole is somewhat swollen).

Head black, mandibles and palpi whitish, antennae brown, the scape paler below; prothorax entirely and mesoscutum except for piceous spot occupying most of the prescutum, the scutellum, the postscutellum, and the alar region rufotestaceous; thorax otherwise and propodeum piceous black; tegulae and front and middle legs except middle tarsi, which are fuscous, whitish; hind leg testaceous with trochanter and base and apex of femur slightly infuscate, the tibia and tarsus fuscous; wings hyaline; abdomen piceous, the tergites narrowly margined with whitish; the second with conspicuous pale gastrocoeli distant from the base.

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[1] Proc. U. S. Nat. Mus., vol. 53, 1917, p. 458.

Type-locality.—Lawrence, Kansas.

Type.—Cat. No. 21640, U.S.N.M. One female taken July 10, 1896, by Hugo Kahl.

Genus SPILOCRYPTUS Thomson.

SPILOCRYPTUS EXANNULATUS, new species.

Female.—Length, 5.5 mm.; antennae, 4.5 mm.; ovipositor, 1.5 mm.

Differs from *polychrosidis* Cushman[1] principally as follows:

Head granularly subopaque, more strongly so on face; vertex convex behind the ocelli, occipital carina not subangulate medially; antennae longer and more slender, first joint of flagellum at least five times as long as thick; propodeal spiracle small, broadly oval; areolet large, the intercubiti nearly parallel. Abdomen with second and third tergites basally shagreened, with sparse, weak punctures, otherwise polished; first tergite stouter, nearly three times as wide at apex as at base; ovipositor about half as long as abdomen.

Head with scape and pedicel, thorax, and abdomen beyond third tergite black, seventh tergite with a very small white spot; first three tergites bright rufo-tastaceous; flagellum and palpi fuscous, the former not annulated with white; mandibiles and tegulae piceous; legs, except apices of hind femora and tibiae and apical joints of all tarsi, which are more or less blackish, bright rufo-testaceous; wing slightly brownish.

Male.—Length, 6 mm.; antennae, 6 mm. Aside from its usual more slender form and longer antennae differs from female principally in having the testaceous of abdomen and legs less brilliant, the antennae nearly black, the hind tarsi blackish nearly to the base, and in lacking the white abdominal spot.

Host.—*Polychrosis viteana* Clemons.

Type-locality.—North East, Pennsylvania.

Type.—Cat. No. 21628, U.S.N.M.

Nine females and 14 males reared by the writer from pupae of the grape-berry moth under Quaintance No. 14440. In size these vary from the size of the types down to 4 mm., the smallest specimen being a female (paratype *h*). This specimen is also colored more like the male. Paratypes *e-h* (females) lack the white abdominal spot.

Below are described a new genus and a number of new species discovered in the United States National Museum. In order to properly define these it seemed advisable to discuss rather fully the genera to which they are assigned, and, since there has been considerable confusion in regard to the position which one of the genera should occupy, to attempt to determine the relation which the group bears to the other groups in the Ichneumonidae. It is hoped that this has been accomplished.

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[1] Proc. U. S. Nat. Mus., vol. 53, 1917, p. 461.

The genus *Helcostizus* (Foerster) Dalla Torre (= *Brachycentrus* Taschenberg) has been variously assigned to the Cryptinae and the Ichneumoninae (Pimplinae), to the former because of its pentagonal areolet, carinate propodeum, petiolate first tergite, and very faintly impressed sternauli, and to the latter because of its evident affinities with *Echthrus* Gravenhorst and its strongly Pimpline habitus. *Cryptoideus* Ashmead was referred by its author to the Cryptinae, where Viereck also placed his synonymous *Xylophruridea*. All of the authors who have placed these genera in the Cryptinae have, however, been content to leave *Echthrus* in the Pimplinae in spite of the fact that it has all of the Cryptine characters mentioned even more strongly developed than has either of the other genera. Rohwer[1] reverses the arrangement, placing *Helcostizus* in the Pimplinae and *Echthrus*, at least as represented by the American species, in the Cryptinae on the lack of the sternauli in the former and their presence in the latter, making this the final character for separating the two subfamilies. It seems evident, however, that the very peculiar inflated front femora, truncate apical joint of the antenna, and medially dentate clypeus should be taken as evidence of their relation to each other rather than that they should be separated by a character that shows such variation as does the strength of the sternauli even in the true Cryptinae.

To the present writer it seems that these three genera and probably *Xylophrurus* (Foerster) Schmiedeknecht[2] form a connecting link between the Ichneumoninae and the Cryptinae not exactly referable to any at present recognized tribe in either subfamily, but Cryptine rather than Ichneumonine. Through *Cryptoideus* the group is much more closely related to *Cryptus* than to any genus in the Ichneumoninae. In the typical *Cryptus* the general form and structure is very similar to that of *Cryptoideus*, the clypeus is of similar structure though lacking the median tooth, the venation is the same, the propodeal carination is similar, the first tergite is similar, and the front tibiae are swollen, though not distinctly inflated nor distinctly constricted at the base.

All of the species discussed will run more or less satisfactorily in Ashmead's key to the Cryptini to either *Xylophrurus* or *Cryptoideus*.

The recent discovery in the United States National Museum of an undescribed species representing an apparently new genus belonging to the group accentuates the relation of *Helcostizus* to the rather dissimilar appearing *Cryptoideus*.

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[1] Proc. Ent. Soc. Wash., vol. 15, 1913, p. 185.

[2] The writer is not familiar with *Xylophrurus*, but from description it seems to be rather closely allied to *Cryptoideus* Ashmead.

The following key will serve to distinguish the three genera:

Areolet small or not defined, second intercubitus wanting or very weak; nervulus postfurcal; nervellus strongly antefurcal; sculpture of body largely finely granulate; propodeum and metapleurum separated by a sharp carina; first abdominal segment not or barely longer than second, broad, only subpetiolate, its ventral margin straight; clypeus sharply, angulately inflexed beyond middle; the entire habitus of the insect strongly Ichneumonine (Pimpline)________________*Helcostizus* (Foerster) Dalla Torre.

Areolet large, complete, the intercubiti strongly convergent above; nervulus antefurcal; nervellus postfurcal or subperpendicular, never antefurcal; body sculpture strong, rough, that of abdomen less strongly so; first abdominal segment usually distinctly longer than second, slender, distinctly petiolate, its ventral margin decurved; clypeus not angulately inflexed; habitus Cryptine ____ 1.

1. Head strongly transverse, cheeks not swollen, temples narrow, their cephalo-candad diameter much less than that of the eye; propodeum with only the basal transverse carina developed, this but slightly curved in the middle, basal median area not at all indicated, spiracle far from base; first tergite with very weak dorsal carinae, the spiracle in or slightly before the middle; head and thorax white marked; wings not banded; front femur in female concave below_____________________*Cryptohelcostizus*, new genus.

Head strongly swollen, temples broad, their cephalo-candad diameter nearly or quite as long as that of the eye; propodeum with the apical carina more or less developed, sometimes obsolete medially, the anterior subangulate or strongly curved medially, basal median area more or less defined, spiracle very close to the base; first tergite with strong dorsal carinae, the spiracle behind the middle; head and thorax without white markings; wings banded or at least infuscate in the region of the stigma; front femur not concave below_____________________________________*Cryptoideus* Ashmead.

Genus HELCOSTIZUS (Foerster) Dalla Torre.

Brachycentrus TASCHENBERG, Zeitschr. Gesammten. Natur., vol. 25, 1865, p. 106.

Mesocryptus THOMSON, Opusc. Ent., fasc. 5, 1873, p. 519.

Asternaulax VIERECK, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 632.

KEY TO NORTH AMERICAN SPECIES, FEMALES ONLY.

Propodeum with two distinct transverse carinae, petiolar area strongly, longitudinally rugose; second intercubitus entirely lacking, the areolet not defined______________________________________*bicarinatus*, new species.

Propodeum with only one transverse carina; areolet defined by position__ 1.

1. Hind tibiae and tarsi black with sharply defined white basal annuli______ 2.

Hind tibiae unicolorous____ 3.

2. Annulus of antenna embracing several joints; propodeum not polished at base; first tergite with broad, indistinct carinae__________*fiskei* (Viereck).

Annulus of antenna very small; propodeum polished at base; first tergite without carinae________________________________*canadensis* (Provancher).

3. First tergite nearly as wide at apex as long; mesoscutum black; vertex opaque shagreened ______________________________*yukonensis* (Ashmead).

First tergite much longer than wide at apex; mesoscutum red; vertex polished______________________________________*rufiscutum*, new species.

HELCOSTIZUS BICARINATUS, new species.

Differs from all other species known to me in the possession of the apical carina of the propodeum with strongly rugose petiolar area and the entire loss of the second intercubitus, the areolet not being defined even by position. In other respects differs only in minor details from *fiskei* (Viereck).

Female.—Length, 10 mm.; antennae, 6 mm.; ovipositor, 1.5 mm. Head rather strongly transverse, cephalo-candad length of temple barely half that of eye; distance between occipital carina and posterior ocellus scarcely longer than postocellar line; face densely, finely punctate; clypeus without a distinct median tooth; malar space shorter than basal width of mandible; thorax above densely, finely punctate, laterally irregularly striato-punctate; propodeum with two transverse carinae, coarsely granulate above, rugose laterally and posteriorly, spiracle much nearer to base than to basal carina; areolet not indicated, the second intercubitus wanting; abdomen coarsely granular, first tergite about three-fourths as wide at apex as long, strongly, almost subangulately, elevated with dorsal carinae broadening out posteriorly into strong ridges.

Black; with antennal annulus embracing more or less of flagellar joints 6–9, palpi, tegulae, and extreme apices of middle abdominal segments white, legs largely red, front coxae black, the extreme apex white, the tibia and tarsus black with white basal annuli, the same pattern but less distinct on middle leg.

Type-locality.—Falls Church, Virginia.

Type.—Cat. No. 21634, U.S.N.M.

Described from a single female taken April 28, 1917, by Wm. Middleton.

HELCOSTIZUS FISKEI (Viereck).

Asternaulax fiskei VIERECK, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 632.
Helcostizus fiskei (Viereck) ROHWER, Proc. Ent. Soc. Wash., vol. 15, 1913, p. 185.

Except for the lack of the apical carina of the propodeum and the defined areolet this species differs from *bicarinatus* Cushman, described above, principally as follows: Cephalo-candad length of temples more than half as great as that of the eye; distance between occipital carina and posterior ocelli much longer than postocellar line; malar space subequal to basal width of mandible; clypeus with a distinct, median tooth; punctuation of entire body much finer and less dense, the propodeum being without rugulosity and very finely reticulate granulate as is also the abdomen; propodeal spiracle about midway between base and basal carina; first tergite nearly as wide at apex as long; color practically the same except that inflated portion of front tibia is whitish with an obscure dark stripe in front, and the antennal annulus is confined to joints 6–8.

Represented only by the unique type.

HELCOSTIZUS CANADENSIS (Provancher).

Mesochorus canadensis PROVANCHER, Nat. Can., vol. 6, 1874, p. 299.
Echthrus canadensis PROVANCHER, Faun. Ent. Can. Hym., 1883, p. 486.

I have not seen this species but Mr. Rohwer, who has examined the type, says that it is a *Helcostizus* and most likely the same as *fiskei* Viereck. The characters used in the key are the only ones in the description of *canadensis* with which the type of *fiskei* does not agree. Provancher says of *canadensis* "metathorax lissé a la base, ponctué au sommet." In *fiskei* the polished portion is at the apex and the sculptured portion at the base. This condition is certainly the more natural one and it seems likely that Provancher inadvertently reversed his statement. The difference between no dorsal carinae on the first tergite and the condition found in *fiskei* may very easily be an individual variation as is certainly the size of the antennal annulus. It is very likely that *fiskei* will have to fall as a synonym of *canadensis*.

HELCOSTIZUS YUKONENSIS (Ashmead).

Pimpla yukonensis ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 445.

Compared with *Helcostizus bicarinatus* Cushman, described above, the type differs as follows: Cephalo-caudad length of temple much more than half that of eye; distance of occipital carina from posterior ocellus much longer than postocellar line; malar space longer than basal width of mandible; clypeus with a median tooth; general sculpture of body finely granular with scattered, weak punctures, more dense on face and in middle of mesoscutum; propodeum with only one transverse carina, finely reticulato-granulate above, irregularly longitudinally striate posteriorly, spiracle but little nearer to base than to carina; aerolet defined; first tergite with dorsal carinae even less distinct beyond summit, nearly as wide at apex as long.

Black with piceous cast, especially on face, and sides of thorax and abdomen; antennal annulus confined to flagellar joints 6 and 7; palpi piceous; middle and hind tibiae and tarsi uniform fucous without basal annuli; front coxae uniform piceous.

More closely allied to the genotype *Helcostizus brachycentrus* (Gravenhorst), which disagrees with the above description principally in having the propodeum without striation behind, the spiracle almost exactly half way between the base and the carina, and in lacking the black color at the apices of the hind femora.

The single paratype is essentially like the type.

HELCOSTIZUS RUFISCUTUM, new species.

Distinct from all of the other North American species in the largely red mesothorax, white front and middle coxae and trochanters, and the narrow, weakly arched first tergite.

Female.—Length, 6.5 mm.; antennae, 4.5 mm.; ovipositor, 1 mm. Very similar in structure and sculpture to *yukonensis*, except that the malar space and temples are slightly shorter, and the first tergite is only about two-thirds as wide at apex as long, only weakly arched, and without dorsal carinae.

Inner orbits, cheeks, clypeus, and scape and pedicel below reddish; flagellar annulus embracing the sixth and portions of the fifth and seventh joints; palpi, propleura, beneath, lower and upper hind margins of pronotum, wing-base, tegula, a line below, front and middle coaxe and trochanters, and the extreme apices of all tergites and sternites white; mesothorax above and below largely rufous, notauli black, running into a triangular brownish spot posteriorly, scutellum rufous, space around bases of wings blackish; metapleura bright reddish piceous, the sterum rufous; body otherwise black to piceous; legs, except as noted, pale testaceous, the front and middle pairs paler, their tibiae whitish above.

Host.—*Phloeosinus*, species.

Type-locality.—Cypress Point, Monterey, California.

Type.—Cat. No. 21635, U.S.N.M.

Described from one female bearing the label "Parasite from gallery of *Phloeosinus* sp. on *Cupressus macrocarpa*, 1903, Hopk. det. No. 18."

CRYPTOHELCOSTIZUS, new genus.

Related to *Helcostizus* (Foerster) Dalla Torre and *Cryptoideus* Ashmead, from which it is readily distinguished by the characters used in the key.

Runs in Schmiedeknecht's key (Genera Insectorum) on the possession of a clypeal tooth to *Xylophrurus* Foerster, but differs in having the head strongly transverse with the temples short and narrow; in lacking the dark alar bands; in the rather small clypeal tooth; in the nongibbous mandibles; in the oval propodeal spiracles; in the weak petiolar carinae; in having the spiracles of the first tergite in or slightly before the middle.

Type.—*Cryptohelcostizus rufigaster*, new species, described below.

CRYPTOHELCOSTIZUS RUFIGASTER, new species.

Female.—Length, 11 mm.; antennae, 8 mm.; ovipositor, 3 mm. Head in front densely rugoso-punctate, the sculpture fading out behind the eyes, temples and cheeks polished, impunctate; clypeus very short, subimpressed beyond middle, broadly, subemarginately truncate, the edge granular with a slight median tooth; malar space slightly more than half as long as basal width of mandible; cheeks slightly convex, temples flat, sharply sloping, their cephalo-caudad length less than a third that of the eye; thorax generally rugosopunctate, lobes of the mesoscutum and the scutellum polished, with separated punctures, notauli deep and extending well back, where they end in a depressed area, which with the notauli is heavily sculptured; sternauli entirely absent; a small highly polished area in upper hind corner of mesopleurum; propodeum transversely ruguloso-punctate, less strongly so in front of the transverse carina, spiracle oval, midway between base and carina; abdomen elongate fusiform, subpolished, with fine scattered punctures; first tergite barely half as wide at apex as long, with a median longitudinal impression, spiracles at the middle; exserted portion of ovipositor about half as long as abdomen; legs slender.

Black; with abdomen and legs largely red; a nearly complete orbital ring, basal transverse mark on clypeus, a minute spot at base of each mandible, dorsal margin of pronotum, tegulae at base, postscutellum, and minute mark on each side of posterior face of propodeum, pale yellowish; palpi piceous; antennae black with yellowish annulus embracing flagellar joints 8 to 9; coxae and basal joints of all trochanters black, legs otherwise reddish testaceous, the hind tibiae and tarsi somewhat darkened; wings hyaline, faintly brownish, veins and stigma blackish, their bases together with the apices of the tegulae brown; abdomen rufous with the lateral margins of tergites 2–5 and apices of 3–5 blackish; sheath of ovipositor black.

A female paratype is essentially like the type but lacks the blackish color of the abdomen and the pale markings of the head are less conspicuous.

Male.—Differs from female principally as follows; abdomen slender and subparallel-sided; first tergite narrower with longitudinal impression weak or absent; spots on mandible, postscutellum, and propodeum lacking; antennae not annulated; hind tibiae infuscate, tarsi black with third and fourth joints white; abdomen in allotype entirely red, in paratype male black at apex.

Hosts.—*Chrysobothris mali* and *Agrilus angelicus.*

Type-locality.—Harold, California.

Type.—Cat. No. 21636, U.S.N.M.

Described from the above two females, reared under United States Department of Agriculture, Bureau of Entomology, No. 6184°, April 10 and 2, 1894, respectively, from the former host in apple, and two males from Los Gatos, California, reared by H. E. Burke under Hopkins U. S. Nos. 14505a2x and 14653a^2 parasitic on *Agrilus angelicus* in *Quercus agrifolia.*

Strikingly Cryptine in general appearance this species has, nevertheless, a strong resemblance to the species of the genus *Helcostizus*, although agreeing with *Cryptoideus* in most of the characters that separate those two genera.

Genus CRYPTOIDEUS Ashmead.

Xylophruridea VIERECK, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 646.

In Schmiedeknecht's key to the Cryptini (Genera Insectorum) the genotype runs, on most of the characters used, to *Xylophrurus* Foerster, but differs from his description of that genus in having the head strongly transverse though wide behind the eyes; the mandibles not gibbous at the base; propodeal spiracles very broad oval; abdomen stout. Within the genus, as defined by the species here included, there is marked variation in all of the above characters except that of the mandibles. The genotype of *Xylophururidea*, *Cryptoideus agrili* (Viereck), has the temples very long and broad, while one of the new species, *Cryptoideus bicolor*, has the abdomen rather slender and the spiracles long oval. This leaves the mandibular character as the only irreconcilable one to separate the two genera.

KEY TO NORTH AMERICAN SPECIES, FEMALES.

Black with abdomen red -------- *bicolor*, new species.
Black -------- 1
Ferruginous -------- 2
1. Legs largely red -------- *nubilipennis* (Cresson).
Legs black -------- 3
2. Malar space longer than basal width of mandible; propodeal spiracle elongate -------- *luctuosus* (Provancher).
Malar space shorter than basal width of mandible; propodeal spiracle round -------- *agrili* Viereck
3. Head posteriorly wider than eyes; apical carina of propodeum obsolete medially -------- *fasciatus* (Ashmead).
Head posteriorly not wider than eyes -------- 4
4. Apical carina of propedeum broadly interrupted in the middle; wings very dark purplish brown -------- *purpuripennis* (Cresson).
Apical carina of propodeum complete; wings subhyaline -------- 5
5. Head behind the eyes as broad as the eyes, the temples not sloping, mostly ferruginous; antennae white annulate; areola not at all defined laterally, the basal carina subangulate medially -------- *rufus*, new species.
Head behind the eyes narrower than the eyes, the temples sloping, mostly black; antennae not annulated; areola defined laterally, the basal carina broadly curved medially -------- *sitkensas* Ashmead.

CRYPTOIDEUS AGRILI (Viereck).

Xylophruridea agrili VIERECK, Proc. U. S. Nat. Mus., vol. 42, 1912, p. 646.

Some additional characters of this species, drawn from type material, that help in distinguishing it from related species are as follows: Temples slightly wider than eyes, straight for most of their length, then abruptly rounding off to the occipital carina; posterior orbits only obscurely brownish; malar space shorter than basal width of mandible; first joint of flagellum longer than second; sternauli weakly indicated anteriorly; propodeal spiracle round; basal carina of propodeum not curved medially to base and with a rather distinct basal area; apical carina broadly interrupted medially; wings hyaline with fuscous stigmal and apical bands, nervellus broken below the middle; exerted portion of ovipositor distinctly less than half as long as abdomen.

CRYPTOIDEUS? LUCTUOSUS (Provancher).

Mesochorus luctuosus PROVANCHER, Nat. Can., vol. 6, 1874, p. 299.
Echthrus luctuosus PROVANCHER, Faun. Ent. Can., Hym., 1883, p. 486.

Because of the elongate spiracle this species is somewhat doubtfully referred to the genus, but in all other ways it seems to agree very well. Notes by Mr. Rohwer, who has seen the type, furnish the following characters which distinguish it from *agrili* (Viereck): malar space longer than basal width of mandibles; eyes rimmed with red; first and second flagellar joints subequal; sternauli indicated posteriorly but not anteriorly, nervellus broken at the middle; basal carina of propodeum curving apparently to base of segment; wings dusky with brownish oblique band below stigma.

Other characters noted by Mr. Rohwer, which evidently ally it closely to *Cryptoideus* and especially to *agrili* are: clypeus rounded, well defined laterally but not basally; inner margins of eyes parallel; front femora swollen beneath from base to beyond middle; occipital carina strong; posterior orbits narrower than eye; head coarsely punctured; notauli present anteriorly; thorax with coarse punctures; nervulus antefurcal; discocubital vein with a stump; pleural carina of propodeum represented by a faint groove; apical carina present laterally; propodeum punctured basad of first carina, behind it longitudinally striato-punctate.

According to Provancher the ovipositor is nearly as long as the abdomen.

CRYPTOIDEUS NUBILIPENNIS (Cresson).

Cryptus nubilipennis CRESSON, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 291.
Echthrus nubilipennis HARRINGTON, Can. Ent., vol. 25, 1893, p. 31.

Differs from *agrili* (Viereck) principally as follows: Head behind slightly narrower than eyes, temples strongly convex; posterior orbits distinctly brownish; flagellar joints 1 and 2 subequal; propodeal carinae strong, the apical very high on upper hind angles; wings yellowish with pale brownish bands; legs beyond trochanters, except apices of hind tibiae, the hind tarsi, and the bases of the front and middle femora, which are fuscous, red; ovipositor nearly as long as the abdomen.

CRYPTOIDEUS BICOLOR, new species.

Differs from all the species here included in coloration.

Female.—Length, 8.5 mm.; antennae, 6.5 mm.; ovipositor, 3.5 mm. Head and thorax densely, rather coarsely, punctate, striately so on temples and the pleura; head seen from above as broad behind the eyes as are the eyes, temples strongly convex, occiput rather shallowly concave, cephalo-caudad length of temple subequal with that of the eye; head from in front nearly round, the cheeks strongly convex, face slightly narrower than frons, malar space slightly shorter than basal width of mandible; sternauli rather strong; antennae slender, first joint of flagellum slightly longer than second; propodeum with apical carina obsolete medially, basal areas punctate, others irregularly rugulose, basal carina strongly curved but not subangulate medially; propodeal spiracles rather long oval; nervellus broken only slightly below middle; abdomen opaquely granulate, the middle tergites weakly, rather densely, punctate; first tergite with strong dorsal carinae becoming obsolete beyond the spiracles, subpolished medially, densely punctate laterally, nearly twice as wide at apex as at base, weakly elevated in the middle; ovipositor three-fourths as long as abdomen.

Black, with posterior orbits brownish; antennae white annulate; clypeus and mandibles piceous; all coxae black, legs otherwise piceous except that the hind femur is bright testaceous and the hind tibia only slightly darkened; tegulae piceous; wings slightly brownish the bands somewhat darker brown; abdomen rufous with the apical segments black; sheath black, reddish at extreme apex.

Type-locality.—Colorado.

Type.—Cat. No. 21919, U.S.N.M.

One female from the C. F. Baker collection.

CRYPTOIDEUS RUFUS, new species.

Female.—Length, 7.5 mm.; antennae, 5 mm.; ovipositor, 2 mm. Head behind eyes as broad as eyes; face slightly narrower than frons; cephalo-caudad length of lower temples distinctly shorter than greatest width of eye; malar space about two-thirds as long as basal width of mandible; clypeus broadly truncate, with a median tooth flanked on either side by a transverse impression; face and frons densely punctate, vertex and temples less strongly so; first flagellar joint distinctly longer than second; thorax densely punctate, striately so laterally; notauli distinct, transversely striate, extending well on to disk of meoscutum; sternauli distinct for about three-fifths their length; propodeum with two complete carinae, the posterior elevated laterally, basal median area weakly defined, basal areas rather sparsely punctate; other areas rugoso-punctate, spiracle round; nervellus broken distinctly below middle, discocubitus angulate with a stump at its middle; first tergite at apex narrower than distance from spiracles to apex, dorsal carinae broadening into ridges beyond spiracle, the space between impressed, the segment finely cariaceous medially, punctate laterally; middle tergites densely, finely punctate, apical ones subpolished; exserted portion of ovipositor half as long as abdomen.

Ferruginous; antennae fuscous, paler at base, nearly black at apex, flagellar joints 7–9 white; palpi fuscous, occiput centrally, notauli, thoracic sutures, alar region, front coxae at base, and ovipositor sheath blackish; wings hyaline with bands pale brownish.

Type-locality.—Montgomery County, Pennsylvania.

Type.—Cat. No. 21637, U.S.N.M.

Described from one female.

CRYPTOIDEUS PURPURIPENNIS (Cresson).

Cryptus purpurpennis Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 364, female.

Cryptoideus purpuripennis (Cresson) Ashmead, Proc. U. S. Nat. Mus., vol. 23, 1890, p. 42.

A specimen of this species in the United States National Museum from Santa Cruz Mountains, California, differs from *rufus* Cushman principally as follows: Much larger, 12 mm. long, head behind eyes narrower than the eyes, the temples slightly sloping; malar space nearly as long as basal width of mandible; propodeum with apical carina interrupted medially, spiracle large, slightly oval; first tergite at apex wider than distance from spiracle to apex; middle tergites minutely, granularly opaque with very fine sparse punctures; exserted portion of ovipositor two-thirds as long as abdomen.

Antennae without white annuli; frons from bases of antennae to and including ocellar triangle medially black; notauli and bases of front coxae not black; wings dark purplish brown, the bands only slightly darker and confined to immediately beneath the stigma. Color otherwise like *rufus*.

CRYPTOIDEUS SITKENSIS Ashmead.

Crytoideus sitkensis Ashmead, Proc. Wash. Acad. Sci., vol. 4, 1902, p. 193.

This Alaskan species is similar in size and structure to *purpuripennis* Cresson, differing structurally principally in having the longitudinal carinae of the propodeum more or less distinct beyond the basal carina, the areolet being completely defined and wider than long, and the punctuation of the abdomen more dense and more distinct. The head is largely black, the ferruginous color being confined to the clypeus, a small spot between the antennae and the eye, and a large spot in the posterior orbit; the thorax black ventrally including the front coxae and bases of middle coxae, the sutures, notauli and alar region more extensively black, this color embracing the postscutellum; the wings very pale brownish with the bands represented by somewhat darker stains in the region of the stigma; otherwise ferruginous.

CRYPTOIDEUS FASCIATUS (Ashmead).

Brachycentrus fasciatus ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 413.

Helcostizus fasciatus (Ashmead) DALLA TORRE, Cat. Hym., vol. 3, 1902, p. 395.

Closely allied to *rufus* Cushman, described above, from which its type differs principally as follows: Head behind eyes distinctly wider than eyes; eyes parallel within; lower temples as long as greatest eye width, striato-punctate; clypeus obtusely pointed; apical carina of propoedum obsolete medially, discocubitus angulate distinctly before the middle.

Colored like *rufus* except that there is a large black spot in the middle of the frons and the ocellar area, the occiput, propleura and front coxae are almost entirely black, and the abdomen is obscurely black at apex.

Subfamily ICHNEUMONINAE (Pimplinae).

Genus GLYPTA Gravenhorst.

GLYPTA MUTICA, new species.

In Cresson's key [1] to the species of *Glypta* runs directly to *vulgaris* Cresson and is very similar to that species, differing from a typical example practically only as follows:

Female.—Length, 7 mm.; antennae, 5 mm.; ovipositor, 4.75 mm.

Head without a horn medially just above the insertion of the antennae; temples strongly rounded; occipital carina subangulate medially; cheeks slightly convex; malar space shorter than basal width of mandible; notauli very weakly impressed; propodeum shorter, the posterior face very abrupt, fully two-thirds as long as dorsal, apical carina very strong, others, especially the anterior transverse and lateral carinae, weaker [2]; metapleura scarcely longer than high; apical lateral impressions of tergites obsolete; ovipositor distinctly longer than abdomen.

Black with scutellum, mesosternum, mesopleura (except space below wings), and metapleura (entirely), red; mandibles, clypeus, tegulae, wing-bases, dorsal margin of pronotum at the side, and a spot immediately below the tegula white; antennae black, brownish at tip; front and middle legs basally stramineous, the trochanters, base of femur and tibia, except apical and subbasal fuscous annuli, nearly white, their tarsi slightly infuscate with the joints whitish at base, femora otherwise pale rufo-testaceous; hind coxae and femora rufo-testaceous, the latter blackish at apex, trochanters whitish, the basal joint more or less reddish, tibia black and white, the black arranged in an apical and a subbasal band connected below by a dark stripe, tarsi black with the joints white at base.

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[1] Trans. Amer. Ent. Soc., vol. 3, 1870, p. 151.

[2] Occasionally in both this species and *vulgris* Cresson all of the propodeal carinae except the apical and median longitudinal are obsolete. From Cresson's description of *vulgaris* this is evidently the case with the type.

Male.—Length, 6 mm.; antennae, 6 mm. Differs from the female in the usual manner for members of the genus in the more slender form, relatively longer antennae, shorter malar space, ventrally pale antennae, paler legs especially the front and middle pairs, deeper notauli, stronger propodeal carinae with narrower areas and the less precipitous posterior face of the propodeum. Otherwise in color and structure much like the female.

Host.—*Polychrosis viteana* Clemons.

Type-locality.—North East, Pennsylvania.

Type.—Cat., No. 21,638, U.S.N.M.

Described from 11 specimens of each sex selected from a large series reared by the author as parasites of the larva of the grape-berry moth, under Quaintance Nos. 10,996, 11,015, 14,441, 14,442, and 14,470.

The paratypes are selected and arranged to show the great variation in color. Paratype *d* is like the type. Paratypes *c* to *a* show the increase in the amount of red, *a* having the three lobes of the mesoscutum red and the scutellum slightly whitish at apex; while *e* to *k* show the progressive encroachment of black until, in *k*, the red is practically eliminated, traces of this color being confined to the scutellum and the lower posterior angle of the mesopleurum. In *i* the white of the pronotum is confined to a small spot in front of the tegula. Paratype *m* is like the allotype except that the scutellum is somewhat paler while in *l* it is distinctly whitish laterally. Paratypes *n*—*s* show the increase in black, *s* being entirely black. Paratype *n*, although having more black on the pleura, has the scutellum paler than in the allotype, while the succeeding specimens have the decrease in red of the scutellum paralleling that of the pleura. Paratypes *t* and *u*, although having much more black on the pleura, have the red much paler, and in *u* the scutellum is black with the apex white.

The black color of the pleura encroaches on the red both from above and from below, the red disappearing last just at the base of the middle coxae.

Variations in size and structure are slight, the most notable being in the degree of convexity of the temples.

Subfamily TRYPHONINAE.

Genus MESOLEIUS Holmgren.

MESOLEIUS BALTEATUS, new species.

In Davis's key to North American members of the genus[1] runs to *idahoensis* Davis, differing from Davis's description as follows: First two tergites rufous at base and apex, black in the middle. third entirely rufous, fourth entirely black, sometimes with more or less reddish reflection; pale color of head and thorax testaceous rather than yellow; legs rufo-testaceous, front pair the palest, tarsi especially of hind legs infuscate, as are also the hind tibiae at apex; antennae paler beneath at base but not at apex; nervellus strongly broken, subdiscoideus distinct; abdomen not compressed at apex; face immaculate.

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[1] Trans. Amer. Ent. Soc., vol. 24, 1897, p. 295.

Female.—Length, 7.0 mm.; antennae 6.0 mm.

Head behind eyes nearly as broad as eyes, temples very strongly convex, polished; malar space very short, granulate; frons granulate and sparsely punctate; face densely punctate; clypeus sparsely punctate, transversely roughened; thorax subpolished, slightly coriaceously roughened; notauli distinct anteriorly; scutellum sparsely punctate; propodeum strongly coricaceous, the lateral carina very strong posteriorly but obsolete before the round spiracles, medially transversely rugose, the rugae forming a more or less distinct apical pseudocarina, the median longitudinal carinae more or less distinct; abdomen minutely, reticulately roughened basally, polished apically; first tergite about half as wide at apex as long, its sides nearly straight, dorsal carinae nearly parallel and extending about two-thirds of the way to apex, lateral carinae strong and complete to apex, spiracles at the middle, those of second tergite at basal third; nervulus slightly postfurcal; nervellus broken at to considerably below middle; discocubitus very strongly bent at middle, the second discoidal cell barely a third as wide at base as at apex; legs slender.

Black with legs largely and abdomen partly reddish; clypeus, mandibles, tegulae, and humeral angle of pronotum flavous; maxillary palpi pale at base, blackish at apex; antennae dark fuscous, scape and first few joints of flagellum paler below; legs reddish testaceous, the tarsal joint except at base and hind tibia at apex infuscate; wings hyaline, veins and stigma brown, veins flavous at base, stigma pale at base and apex; abdomen black with third tergite entirely and first and second at base and apex rufous.

Host.—*Ametastegia glabrata* Fallen.

Type-locality.—Wenatchee, Washington.

Type.—Cat. No. 21707, U.S.N.M.

Described from seven females reared under Quaintance No. 14066 by Mr. E. J. Newcomer, of the Bureau of Entomology.

In this series there is some variation in size, the smallest being 5 mm. long. The greatest variation in structure is in the arrangement of the rugosity of the propodeum. In some of the specimens the median carinae extend to the apex and the petiolar area is not defined, while in others the apical carina is dissipated into a number of irregular rugae. The color variation is slight, consisting principally in the possession by some specimens of more or less fuscous on the third tergite and by others of reddish reflections on the fourth.

PROTEROCRYPTINI, new tribe.

Examination of the type of *Proterocryptus nawaii* Ashmead, type of the genus *Proterocryptus* Ashmead,[1] discloses the fact that it is not Hemiteline, as Ashmead considered it, nor even Cryptine, but rather Tryphonine. In the Tryphoninae it will not run to any of the tribes tabulated by Ashmead, but in Forester's key to his families of Ichneumonidae[2] it runs, on the origin of the radius near the base of the stigma and the petiolate abdomen, to the Sphinctoidae (tribe Sphinctini Ashmead), but differs from *Sphinctus* Gravenhorst, the only included genus, in many characters of apparent tribal value. In addition to the two characters mentioned above it resembles *Sphinctus* in the globular thorax, the confluent areola and petiolar area, the strongly petiolate abdomen, the distinct gastrocoeli distant from the base on the second tergite, and, except that the second intercubitus is lacking and the aerolet therefore open, in the venation of the front wing. It differs from *Sphinctus* principally in the following characters: Head very strongly transverse, almost lenticular, the temples nearly flat and very sharply sloping to the rather weak occipital carina; eyes parallel within and sharply emarginate opposite the antennae; clypeus small, flat, broadly rounded at apex; scutellum slightly convex, not margined, separated from the mesoscutum and postscutellum by rather broad crenulate furrows instead of by deep narrow slits, postscutellum also not strongly margined; propodeum completely though weakly areolated, except that areola and petiolar area are confluent, spiracle situated very near to the junction of the lateral carina and the costella; prepectal carina very high and flangelike ventrally; first abdominal segment clavate, the spiracles not prominent, the tergite and sternite completely fused and not separated by either carina or groove; ovipostor exserted (in the genotype as long as the first tergite); second intercubitus completely absent; longitudinal veins of hind wing, except metacarpella, vestigial beyond the transverse veins, the intercubitella placed so far basad of its normal position as to give the wing a strongly Braconid appearance; hind tibia with two apical spurs.

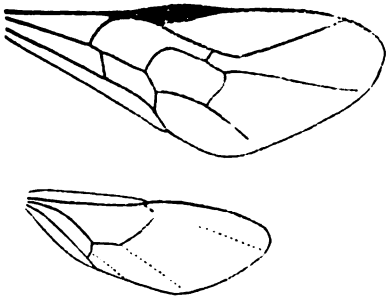

FIG. 1.—WINGS OF PROTEROCRYPTUS NAWAII ASHMEAD.

The venation of both front and hind wings is shown in figure 1.

The tribe includes only the genus *Proterocryptus* Ashmead.

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[1] Proc. U. S. Nat. Mus., vol. 30, 1906, p. 174, pl. 12, fig. 3.

[2] Verh. naturh. Ver. preuss. Rheinl., vol. 25, 1868.

REPORT ON A COLLECTION OF COPEPODA MADE IN HONDURAS BY F. J. DYER.

By C. Dwight Marsh,
Of the United States Department of Agriculture.

This collection was contained in a series of bottles numbered from 1 to 69, and the material was collected at various times between November 28, 1915, and September 29, 1916. Every month was represented during that period except August. The numbers of Copepoda were very small, and so many of the individuals were immature that specific determination in many cases was impossible. All of the collections were made at La Ceiba.

Following is a list of the species found.

Diaptomus marshi Juday.
Cyclops leuckarti Claus.
Cyclops albidus Jurine.
Cyclops serrulatus Fischer.
Cyclops prasinus Fischer.
Cyclops ceibaensis, new species.
Cyclops panamensis Marsh.
Cyclops varicans Sars, determination doubtful.
Canthocamptus, species probably *staphylinus*.

DIAPTOMUS MARSHI Juday.

Diaptomus marshi Marsh, 1913, pp. 10–12, pl. 2, figs. 1–5.—Juday, 1914, pp. 803–805, figs. 1 and 2.
Diaptomus colombiensis Thiébaud, 1914, pp. 161–163, figs. 1–5.
Diaptomus marshi Pearse, 1915, p. 540.

This species was discovered by Mr. Chancey Juday in Guatemala. Although it was first described by Mr. Juday in a paper presented to the Wisconsin Academy, and it was understood that Marsh's description of the Panama specimens should appear after the publication by Juday, by reason of an unexpected delay in the publication of the Transactions of the Wisconsin Academy, Marsh's paper unfortunately appeared in print before Juday's. Juday found the species near Puerto Barrios and Los Amates in Guatemala. Marsh found it in two localities in the Canal Zone.

Proceedings U. S. National Museum, Vol. 55—No. 2285.

Thiébaud's *colombiensis*, which is, without doubt, identical with *marshi*, was found in a small lake near Bogota. Pearse, 1915, reports it as common at Fundacion in northern Colombia. The occurrence in Honduras is of considerable interest, as it extends farther the known range of the species. There is every reason to expect that further collections will show that it occurs also in the other Central American States.

It was found in Honduras only in the collections made in September and December.

CYCLOPS LEUCKARTI Claus.

Cyclops leuckarti was found at all times of the year, and was, perhaps, the most common species. It is cosmopolitan in its distribution, so that no especial significance is attached to its occurrence in Honduras.

CYCLOPS SERRULATUS Fischer.

Cyclops serrulatus was found in only three collections, but it is world wide in its distribution, and can be expected in any locality.

CYCLOPS PRASINUS Fischer.

Cyclops prasinus is another species that occurs widely distributed in practically all parts of the world, being especially characteristic of lakes. In the Central American region, Juday has previously reported it from Guatemala and Marsh from Panama.

CYCLOPS CEIBAENSIS, new species.

Plate 49.

This small and very interesting species was found in only three collections, two of them being made on September 27, 1916. The number of individuals was small, and not as many preparations could be made as would have been desirable. There is no doubt, however, that this is different from any previously described species, and it seems wise to define it so far as the material will permit, leaving further details to future collections. The type is catalogued under No. 57392 in the collection of the United States National Museum.

The last cephalothoracic segment is extended into lateral wings, each side being armed with a long prominent seta, as shown in figure 5.

The abdomen (fig. 5) is slender. The first segment is enlarged at its anterior end and equals in length the two succeeding segments. The remaining abdominal segments about equal each other in length. The last segment is armed posteriorly with minute spines.

The furcal rami are slender, and equal the combined length of the last two abdominal segments. The lateral setae are situated at the distal third of the furcae. Of the four terminal setae (fig. 1), the outer and inner are short, the inner being the longer of the two.

The longest of the terminal setae equals in length the whole abdomen, including the furcae.

The first antennae are short, composed of twelve segments, which have no distinctive armature. The antenna is shown in figure 4.

The rami of the swimming feet are 2-segmented. The spinous armature of the terminal segments of the exopodites is represented by the formula 3, 3, 4, 3. Figure 3 shows a fourth foot.

The fifth feet are 1-segmented. The segment is slender, nearly five times as long as its greatest width. A little more than midway of its length on the inner side there is a minute lateral spine, and the distal portion of the segment is somewhat narrower than the proximal part. The segment is terminated by a long seta. The foot is shown in figure 2.

C. ceibaensis resembles very closely *C. varicans.* In its general form, the form and armature of the furca, and the character of the first antenna, it can not be distinguished from that species. The spinous armature of the expodites of the swimming feet is different, however. The principal distinction is the form of the fifth feet. The segment in *varicans* has no armature except the terminal seta, while in *ceibaensis* there is a minute lateral spine.

The material available did not permit of a determination of the form of the receptaculum seminis.

CYCLOPS PANAMENSIS Marsh.

Cyclops panamensis was found in collections made in March and in August. The only preceding record of this species was by Marsh, 1913, who found it on the savannas between Panama and Old Panama. The occurrence in Honduras would indicate a probable fairly wide distribution in Central America.

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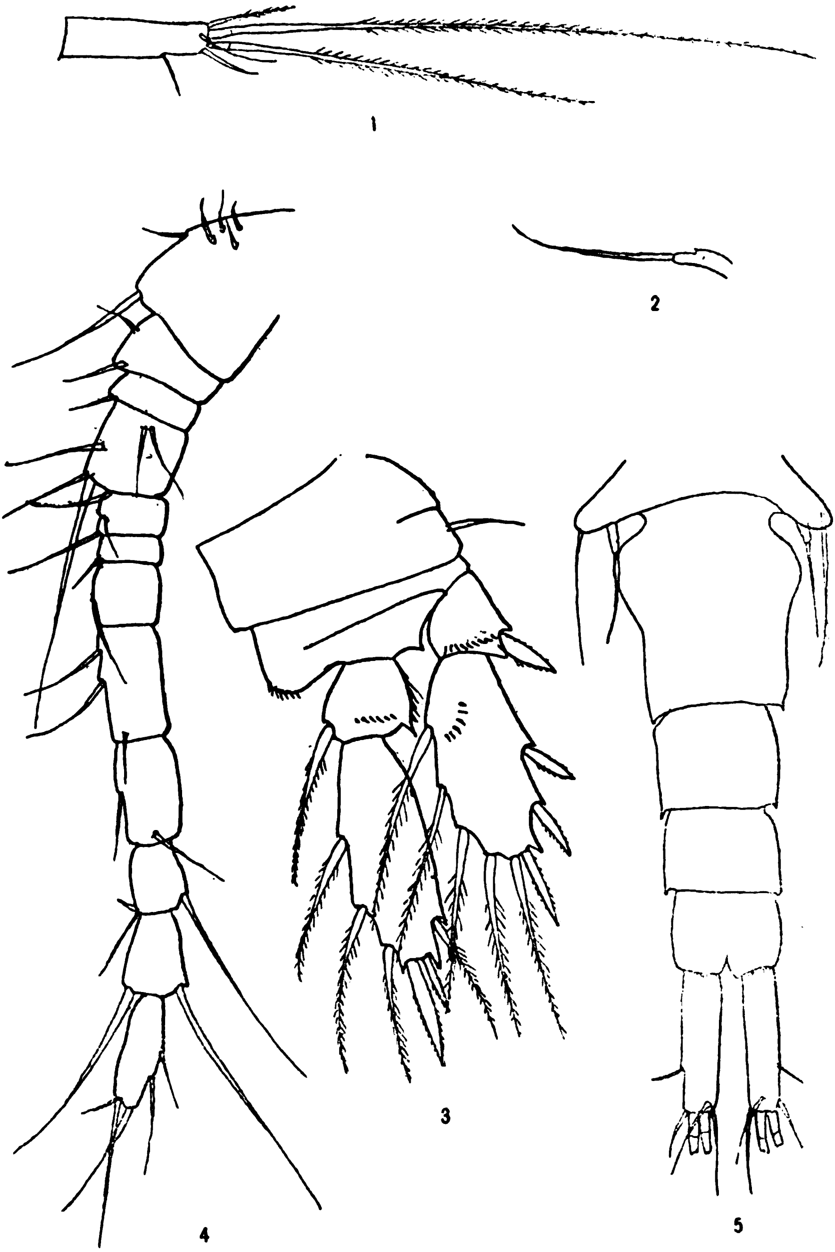
EXPLANATION OF PLATE 49.

FIG. 1.—*Cyclops ceibaensis*, furca × 277.
2.—*Cyclops ceibaensis*, fifth foot × 583.
3.—*Cyclops ceibaensis*, fourth foot × 583.
4.—*Cyclops ceibaensis*, antenna × 583.
5.—*Cyclops ceibaensis*, abdomen × 277.



A NEW COPEPOD (CYCLOPS CEIBAENSIS) FROM HONDURAS.

FOR EXPLANATION OF PLATE SEE PAGE 548.

NORTH AMERICAN PARASITIC COPEPODS BELONGING TO THE NEW FAMILY SPHYRIIDAE.

By Charles Branch Wilson,

Department of Biology, State Normal School, Westfield, Massachusetts.

INTRODUCTION.

This is the fifteenth [1] paper in the series dealing with the parasitic-copepods in the collection of the United States National Museum, and comprises a new family to be called the Sphyriidae.

The genera of this family are closely related to the Lernaeidae, but differ in their life history and in several important morphological characters. Instead of disappearing after the copepodid stages, as in the Lernaeidae, the male persists as a pigmy adult, attached to the body of the female, as in the Lernaeopodidae. Hence sexual maturity is not reached during the last copepodid stage, and both sexes are subsequently changed greatly in body form and structure. Similarly fertilization does not take place previous to the attachment of the female to her host, but after that event and the metamorphosis which follows it, and the spermatophores are attached to the vulvae in the usual manner. The females become even more grotesque and bizarre than those of the Lernaeidae, so that in spite of their paucity of species the genera surpass all the other parasitic copepods in morphological transformations. It is to be regretted that no material is available for the life history of any of the genera, since it probably differs in several essential particulars from any yet recorded. But unfortunately all the species are parasites of fish which frequent the open ocean, and the great majority of which are found only at considerable depths. Consequently the developmental stages are very difficult of access, and the chances are all against their acquisition. We must be satisfied, therefore, with the morphological and structural details of the adults.

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[1] The 14 preceding papers, all of which were published in the Proceedings of the United States National Museum, are: 1. The Argulidae, vol. 25, pp. 635–742, pls. 8–27. 2. Descriptions of Argulidae, vol. 27, pp. 627–655, 38 text figures. 3. The Caliginae, vol. 28, pp. 479–672, pls. 5–29. 4. The Trebinae and Euryphorinae, vol. 31, pp. 669–720, pls. 15–20. 5. Additional Notes on the Argulidae, vol. 32, pp. 411–424, pls. 29–32. 6. The Pandarinae and Cecropinae, vol. 33, pp. 323–490, pls. 17–43. 7. New Species of Calignae, vol. 33, pp. 593–627, pls. 49–56. 8. Parasitic Copepods from Pacific Coast, vol. 35, pp. 431–481, pls. 66–83. 9. Development of Achtheres ambloplitis Kellicott, vol. 39, pp. 189–226, pls. 29–36. 10. The Ergasilidae, vol. 39, pp. 263–400, pls. 41–60. 11. Descriptions of New Genera and Species, vol. 39, pp. 625–634, pls. 65–68. 12. Descriptions of New Species, vol. 42, pp. 233–243, pls. 30–34. 13. The Lernaeopodidae, vol. 47, pp. 565–729, pls. 25–56. 14. The Lernaeidae, vol. 53, pp. 1–150, pls. 1–21.

The material for the present paper was derived from several sources. The first and by far the most important one was the collection of the United States National Museum, which included the new genus *Periplexis* and the various species of *Rebelula* and *Sphyrion*. Then a number of drawings have been generously placed at the author's disposal, including a fine series by Dr. Richard Rathbun and two drawings by J. H. Blake on *Sphyrion lumpi*, a second series by Rathbun and a single drawing by Blake on *Rebelula bouvieri*, a single drawing by Blake of the new species, *Rebelula gracilis*, and two drawings of the new genus *Periplexis* by A. H. Baldwin.

These drawings by Blake and Baldwin were made in 1882 and 1887, and it is fortunate that they are finally to be published.

The specimens of the genus *Opimia* were obtained by Dr. J. C. McClendon from a shark at La Jolla, California, while those of both species of the new genus *Paeon* were obtained by the present author from sharks at Beaufort, North Carolina, while in the employ of the United States Bureau of Fisheries.

In the examination of specimens the same methods have been used as in the Lernaedidae; they were dehydrated in absolute alcohol and cleared in clove oil, or better still in oil of wintergreen. In consequence they became so transparent that the internal anatomy was visible in all its details. The pigmy males, after such treatment, were mounted *in toto* in Canada balsam on culture slides and are preserved in this manner.

Serial sections have also been made of one of the partially developed females of *Sphyrion lumpi*, thus supplementing the work with the cleared specimens.

As here constituted the family is made up of six genera, two of which, *Periplexis* and *Paeon*, are new to science, and 14 species, of which the females of five are new, as well as all the males.

HISTORICAL.

Quoy and Gaimard seem to have been the first to discover any of the species belonging to this family. They figured and described in the report of Freycinet's voyage around the world (1824) a parasite which they referred to the genus *Chondracanthus*, and to which they gave the French name "lisse." Cuvier (1830) recognized that this species did not belong to the genus *Chondracanthus*, and with it as a type he established the new genus *Sphyrion* (vol. 3, p. 257). Guérin (1829–1844) translated the French name "lisse" into the Latin equivalent *laevigatus* (vol. 2, pl. 9, fig. 4), but added nothing further to the description.

Burmeister (1823) did not include the genus in his family "Penellina" because he was unacquainted with any of the species, but in a footnote (p. 319) he said that *Sphyrion laevigatus* evidently formed a valid genus between *Lernaea* and *Lernaeocera.*

Milne Edwards (1840) claimed that the genus *Sphyrion* was too imperfectly known to be located definitely, but that it probably ought to be placed between the "Penelles" and the "Lernées" (p. 525).

Steenstrup and Lütken (1861), judging from the figures published by Quoy and Gaimard, Guérin, and Cuvier, said that the genus did not belong with the Lernaeidae but with the Chrondracanthidae (p. 432).

Krøyer (1845) found a similar species parasitic upon a lumpfish, but failed to recognize that it belonged to the genus *Sphyrion*, and created for it a new genus, which he called *Lestes*, with the species *lumpi* (p. 217). But the name *Lestes* had been used by Leach in 1817 for a genus of dragonflies and so Krøyer changed to the feminine *Lesteira* in 1863 (p. 325), when he gave a more detailed description of the species. This last name accordingly becomes a synonym of *Sphyrion.*

But Krøyer did not agree with Steenstrup and Lütken in placing the genus amongst the Chrondracanthidæ; he was rather of the opinion that it belonged with the Lernaeocerans. Although his genus name has become a synonym his species was valid, and these two species, *laevigatus* and *lumpi*, were at first the only ones in the genus.

In describing the crustacea of the voyage of the *Nassau*, Cunningham (1871) added a third species of *Sphyrion*, to which he gave the name *kingi* (p. 501).

Thor (1900) had an opportunity of examining more in detail Quoy and Gaimard's type-specimen of *Sphyrion laevigatus*, but for some unexplained reason he preferred to call it "*laevis*" instead of *laevigatus* (p. 277). He also described and figured a species new to science, *S. australicus*, and mentioned another new species, *norvegicus*, without giving any figures or description. And finally Quidor (1912) added a new species *delagei* (p. XLI), and on the following page another new species, *stewarti.* He also on page XLIII described a new genus and species, *Hepatophylus bouvieri.* This new genus, together with *Sphyrion*, he placed in the Lernaeidae because they showed torsion, which he claimed was exhibited nowhere outside of that family. Bassett-Smith (1899) in his systematic Review of Parasitic Copepods (p. 489), and Stebbing (1900) in his South African Crustacea (p. 60), changed the gender of the specific name to agree with that of the genus, making it *laevigatum.*

In 1853 Kölliker created a new genus of parasitic copepods to which he gave the name *Lophoura.* This was described in great detail and accurately figured by Cornalia in 1865. But the name *Lophoura* had been preoccupied by Fleming in 1822 for a genus of birds, and hence Poche in 1903 proposed the new name *Rebelula*, which has been adopted.

P. J. van Beneden discovered a parasite which he described and figured in 1851 as *Lernaeonema musteli;* this was renamed *Trypaphylum musteli* by Richiardi (1878), who added nothing to the description. But later T. and A. Scott (1913) supplemented the description of the female and added one of the male, with excellent figures of both sexes (p. 159, pl. 45, fig. 6; pl. 51, fig. 1; pl. 49, figs. 1–7).

ECOLOGY.

Sexual dimorphism.—The female sphyriid is a fixed parasite and has completely lost not only the power of locomotion but also the swimming legs and often most of the other appendages. Furthermore her body has been transformed in size and structure to a greater extent than in any other family of copepods. Consequently we find here very marked sexual dimorphism in locomotion, in prehension, and in morphology, which will be taken up under these headings respectively.

Locomotion.—Although we know nothing of the development of any genus in the family, we are safe in saying that the larvæ alone possess the power of free swimming, but we can only surmise for how long a period it continues. During this period, whatever its length may be, both sexes fasten upon their future host, after which their subsequent development varies greatly.

Female.—We are not obliged to suppose that the female eventually fastens to the first spot upon the fish's body that she happens to come in contact with. In all probability she can move about over the external surface and thus exercise a choice as to her final location. It may fairly be said that this is proved by the fact that so many of the species are found fastened near the base of the dorsal fin. It would hardly be possible for them all to hit that spot upon their first trial. The necessary locomotion over the surface of the body of the host is accomplished by means of the maxillæ and maxillipeds as in the male. But, having once reached a suitable and satisfactory location, and having commenced to burrow, all locomotion on the part of the female ceases and she becomes permanently fixed for life.

Male.—Similarly the male moves about over the surface of the host, and also over the body of the female, after he has once fastened to her. This movement is accomplished by means of the second maxillae and maxillipeds, in a manner similar to that of the Lernaeopod male. In the genera *Rebelula* and *Sphyrion* the structure of the antennae shows them to be absolutely unfit to take any part in locomotion. And in *Paeon*, while the second antennae are furnished with weak chelae, the appendages themselves are so small and short that they are not capable of doing any real work. The locomotion of the *Rebelula* male is doubtless greatly facilitated by the increased length of the basal joints of the maxillipeds. This makes possible a much longer reach between the second maxillae and the maxillipeds, and the male must be able to move about quite freely. The males retain the ability to perform this sort of locomotion during life. But after they have found their host, or after they have attached themselves to the body of the female, they lose their swimming legs, so that they are no longer capable of free swimming. These males thus go a step farther than those of the Lernaeopods, for the latter sometimes retain their swimming legs although they are no longer of any service as locomotor organs.

Prehension.—The organs of prehension are the same as those with which the parasite crawls about over the body of its host, namely the second maxillae and maxillipeds. And the male continues to use them for both purposes throughout life. Accordingly we find that these organs persist in the male, that they increase in size with the growth of the body, and that they retain a very well-developed set of muscles, which renders them efficient for both prehension and locomotion. But the female, after she has once burrowed into the tissues of the host, develops processes or horns, or both, upon the sides of the cephalothorax, which anchor her firmly in a fixed position, so that she has no further need for organs of prehension. And the maxillae and maxillipeds, thus rendered useless, entirely disappear, or if they persist they do not increase in size with the enormous increase of the female's body, and evidently do not function at all as prehensile organs.

Burrowing.—While the genera belonging to the Sphyriidae are much more limited in their choice of a point of attachment than those of the Lernaeidae, and while none of them, so far as yet known, ever burrows into the fish's heart, or penetrates the tissues of its host to anything like the distance accomplished by *Pennella*, nevertheless their burrowing is similar in all respects to that of the Lernaeidae, and is probably accomplished in the same manner. Fortunately a few of the specimens in the United States National Museum collection had been secured by cutting out a block of the tissues of the host large enough to include all of the parasite's head and neck. In this way it was possible to determine that the dorsal aorta was the blood vessel usually sought, and that, in reaching it, the parasite found the same difficulties noted in the Lernaeidae.[1] But in the present family the second attennae can not take as prominent a part in the burrowing as they did among the Lernaeids, and accordingly it must

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[1] Proc. U. S. Nat. Mus., vol 53, p. 16.

be accomplished chiefly by the mouth parts. There is also an elongation of the thorax accompanying the burrowing, but it differs from that of the Lernaeids in one important particular. In the Lernaeidae, as is shown by the persistence of the swimming legs, close together and just behind the head, the elongation is produced by the fifth and sixth thoracic segments. The only exception is found in the genera *Peniculus* and *Lernaea*, in which the anterior segments of the thorax take part in the elongation. In the former genus, *Peniculus*, the second and third segments are slightly elongated, so that the four pairs of legs do not stand close together, but while the first and second pairs are still in juxtaposition, the third and fourth pairs are each removed to a little distance posteriorly. But even here the so-called neck ends with the third segment, and the remaining segments are fused into a common trunk. In *Lernaea* each thorax segment contributes its share to the elongation, and each pair of legs is removed from the one which precedes it by a distance which increases as we proceed backward, bringing the fourth legs close to the posterior end of the body. And there is often a fifth pair of rudimentary legs just over the bases of the egg strings, in a position corresponding to that found in the Caligidae. But there is no real neck, the anterior thorax passing insensibly into the posterior, with no definite line of demarkation.

Here in the Sphyriidae also all the thorax segments take part in the elongation, but in females like the one represented in figure 68, on which portions of the swimming legs still persist, it can be seen that each pair is separated from the one preceding it by a distance which at first increases and then decreases as we proceed backward. This means that the third and fourth segments contribute more than the others to the elongation. Moreover, the position of the fourth legs at the anterior end of the trunk shows that the latter is really a fusion of the fourth, fifth, and sixth segments.

Torsion.—With reference to torsion the same may be said that has already been given in the case of the Lernaeidae.[1] In burrowing through the tissues of the host the head of the parasite does not always come in contact with the dorsal aorta, and the parasite has to burrow to the right or left in search of it, thereby producing a twisting of the body around its longitudinal axis. If the burrowing starts on the right side of the host, the head is more often turned to the left in search of the aorta; if on the left side, it is more often turned to the right; if on the median line behind the dorsal fin, it may be turned in either direction to get around the vertebral column. As a result we find varying degrees of direct or inverse torsion as in the Lernaeidae, and similar torsion must be found in any parasite that thus searches by burrowing for some convenient source of its food supply. But we can not argue either that such genera belong to the Lernaeidae simply because they show torsion, or that the amount and direction of torsion is constant enough to furnish specific characters. Since the male never burrows but remains free upon the outside of the body of the host, or upon the body of the female, it never exhibits torsion.

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[1] Proc. U. S. Nat. Mus., vol. 53, p. 10.

Food.—As in the Lernaeidae, the simple fact that the females thus burrow through the tissues of the host until their mouth is brought in contact with some blood vessel is sufficient proof that the fish's blood constitutes their food. The male is provided with a well developed sucking proboscis and with the ordinary piercing mouth parts found in other male parasitic copepods. The body also contains digestive and excretory glands as well developed as those of the Lernaeopod males, and in addition the posterior portion of the digestive tract is fully developed, with an anus opening to the exterior. It seems reasonable, therefore, to assume that the male also feeds upon the blood of the host, at least until it takes a position on the body of the female. And even then, so deeply is the female buried in the tissues of its host, the male would not have far to crawl in order to reach the fish's skin.

Hosts.—The species of this family are confined entirely to salt water fishes, and further to deep-sea forms, or at least to those that live in the open ocean. The two species of the new genus *Paeon* and the single species of *Trypaphylum* are found in the gill cavity of sharks. The other species are found either in the gill cavity or on the outside surface of various deep-sea fishes ranging from the African cod to the common rat-tail off our North American coast.

Parasites.—All the specimens examined by the author except those of *Paeon versicolor* have proved to be remarkably clean and free from parasities or messmates, either animal or vegetable. In a single specimen of *Rebelula bouvieri*, taken from *Macrourus bairdii*, the part of the body which hung free outside the fish's skin was completely covered with a dense growth of algae.

EXTERNAL MORPHOLOGY.

The body of a Sphyriid is divided into three distinct regions—a cephalothorax made up of the head and first thorax segment, a long slender neck, chitinous and sometimes filose, and a trunk made up of a little of the posterior end of the fourth thorax segment, all of the fifth and sixth segments and the abdomen.

In *Opimia* the cephalothorax is smooth and destitute of processes or horns, in all the other genera it is profoundly modified by outgrowths and enlargements. These may take the form of soft processes or chitin horns. The soft processes are found on the front and sides of the cephalothorax and may be small and more or less spherical in shape, or produced into immense foliaceous affairs, larger than all the rest of the body and themselves covered with secondary processes, simple or branched.

This condition occurs in the genus *Sphyrion*, but to interpret the secondary processes as modified legs (pattes transformés), as was done by Thor (1900, p. 280) and Quidor (1912, p. XLI), is manifestly out of the question. That would render it necessary for us to assume the fusion of the entire thorax with the head, which the breaks in the longitudinal musculature show to be impossible. These soft processes have thin walls and are filled with spongy chitinogen tissue, which is continuous with that filling the cavity of the cephalothorax proper.

The horns are of narrow diameter and fully chitinized; they are found at the junction of the cephalothorax with the neck, and are developments of the latter, as is shown in the new genus *Periplexis*, where they are developed over a considerable portion of the anterior neck, and also in the genus *Rebelula*, where the entire neck is often covered with chitin knobs. They may be either simple or branched, the branching sometimes becoming very profuse, as in the new species, *Rebelula cornuta*.

In *Periplexis* and *Rebelula* the cephalothorax is an elongated cylinder, with all the soft processes at the anterior end, which is the true head. The remaining thoracic portion may be either smooth, as in most species of *Rebelula*, or transversely wrinkled, as in *Periplexis* and *Rebelula cornuta*.

This wrinkling, however, may be more or less the result of preservation.

The neck, with the exception of the modifications just noted, is usually smooth and of the same diameter throughout, but may be enlarged a little posteriorly (*Sphyrion*) or wrinkled where it joins the trunk (*Paeon*). Since these outgrowths of the head and neck are modifications which begin only after the female has burrowed into the tissues of the host, and which increase in complexity with subsequent growth in size, it is evident that they possess but little specific value. At all events two species of the same genus can not be satisfactorily established upon these characters alone, as has been attempted in the genus *Sphyrion*. If young females can be compared, differences in the position, arrangement and form of the outgrowths will have far more value than in older and more mature specimens. But even then the chief basis of differentiation must be the form and structure of the appendages. Because of the scarcity of the younger stages and because the adult female looses most of her distinguishing appendages, we must of necessity turn to the male for diagnostic characters.

The trunk is more or less enlarged and flattened dorso-ventrally; it is usually heart-shaped, the apex of the heart joining the neck, but it assumes an elongated club shape in *Opimia* and *Paeon ferox.* The surface is normally smooth and convex, but as a result of the contraction of the internal dorso-ventral muscles it may become pitted when those muscles are universally distributed, or may exhibit a few larger depressed areas, symmetrically arranged, when the muscles are gathered in bunches. The wall of the trunk is rather thin and so soft that in some species, such as *Paeon ferox*, it is easily pressed out of shape. In young females the posterior end has not yet assumed the typical heart shape, but is narrowed into a rounded lobe terminated by large anal laminae (see fig. 17). As growth progresses and the heart shape, with its median sinus and lateral lobes, is assumed the rounded lobe disappears and the anal laminae become flattened together and thickened until in the mature adult they form together a small hemispherical knob, nearer the dorsal than the ventral surface. On either side of the laminae and ventral to them is a genital knob, out of which opens the oviduct.

From the dorsal surface of the genital segment and the anal laminae arise a pair of posterior processes. These may develop into long, smooth, simple cylinders (*Opimia*, *Paeon*), or they may become lobed (*Periplexis*), or they may begin to branch and the branches may divide dichotomously until they assume a fancied resemblance to bunches of grapes (grappes de rasins) as in the genus *Sphyrion*, or each branch may grow into a long and narrow cylinder, in which event the whole process is likened to a tuft of hair (faisceau de poils) as in the genus *Rebelula.*

Here again, of course, the size and complexity of the final mass will depend largely upon the age of the specimen examined, and will be of practically no value in determining species.

The egg strings are straight and cylindrical and the eggs inside them are small and multiseriate, but are not arranged definitely in rows as in the Lernaeopodidae.

The appendages are the same as in the Lernaeidae, namely, two pairs of antennae, a pair of mandibles, two pairs of maxillae and a pair of maxillipeds. But these can only be seen in young females and males; some or all of them are wanting in the matured female adult.

The first antennae in the young *Sphyrion* female (fig. 18) are on the anterior surface of the head, dorsal to the mouth tube, and are minute in size and destitute of setae. The second pair are at the sides of the mouth tube; they have swollen basal joints and are tipped with the rudiments of a chela. The mouth tube is at the center of the antero-ventral margin of the head and is directed diagonally forward and downward. It is made up of a distinct labium and labrum, the former of which is fringed at the tip, and the two are joined so as to leave an opening on either side. The mandibles are inside the tube and are stylet-shaped, their adjacent surfaces set with a row of fine teeth.

The first maxillae are on the outside of the tube; each is one-jointed and tipped with a tiny spine. The second maxillae are on the ventral surface of the head behind the mouth tube; each consists of a simple finger-like joint, projecting ventrally and tipped with a small claw.

The maxillipeds are considerably larger, and each consists of a basal joint fused with its mate across the midline and a free terminal joint tipped with a stout claw. As growth progresses and the various processes grow out upon the cephalothorax some of these appendages usually disappear, or they may be changed somewhat in position, so that in the mature adult they are hard to find. But careful search will usually reveal at least some of them. The swimming legs are very quickly broken off and are never found upon the adults of either sex. But on the same young female whose mouth parts are shown in figure 12 there were the remains of the first and fourth pairs. The first pair were on the cephalothorax and the fourth pair on the anterior end of the trunk. We can judge where the others must have been by the breaks in the longitudinal musculature.

INTERNAL MORPHOLOGY.

Body wall.—The body wall is similar to that of the Lernaeidae, being made up of two layers, an outside transparent layer, which in this family never becomes chitinous except in the neck and horns, and an inner opaque layer, made up of cells containing nuclei.

The outer layer is quite thin over the cephalothorax and trunk in *Paeon*, but is conspicuously thickened in the neck and at the posterior corners of the genital segment; in *Sphyrion* and *Rebelula* it is thick and leathery all over the body. It is made up of thin lamellae packed closely together without intervening spaces, and contains pore canals connected with the inner layer. The latter varies in thickness in different parts of the body, but nowhere attains anything like the depth found in some of the Lernaeidae. Nor does it anywhere form glands like those seen in *Sarcotretes* and other Lernaeids. But it does make up a spongy tissue which fills the cephalothoracic and posterior processes, as well as those portions of the cavity of the head and trunk not otherwise occupied. In bulk, therefore, it is by far the most extensive tissue in the body.

Muscular system of the female.—We know nothing of the musculature of the free swimming larva, but it must of necessity be more extensive and complicated than that of the adult. The youngest of the developmental stages of *Sphyrion* here mentioned shows the same muscles as the matured adult with one exception. There is in this stage (fig. 30) a complex system of dilator muscles running forward and backward from the junction of the genital segment and abdomen to the sides of the barrel-shaped rectum. These indicate that the rectum takes an important part in respiration during early development. But although the rectum is retained in the matured adult and increases in size with the growth of the rest of the intestine, these dilator muscles do not increase accordingly. They become restricted to that part of the rectum contained in the abdomen, and when the latter is finally reduced almost to nothing these muscles are too weak to accomplish much.

There are no muscles connected with the first antennae in any female thus far examined, but the second antennae show a well developed musculature. The presence of corresponding muscles in two spherical processes on the head of *Rebelula* indicates that these processes are really the remains of the second antennae, because the other cephalothoracic processes do not possess muscles.

In *Paeon* there are very strong muscles connected with the second maxillae, while the musculature of the maxillipeds is weak and practically useless. In *Sphyrion*, on the contrary, the musculature of the second maxillae is comparatively weak, while that of the maxillipeds is much stronger, although relatively not as strong as in the maxillae of *Paeon*.

The muscles connected with the swimming legs of the larva entirely disappear in the adult.

The body muscles of the female are separated naturally into two sets, the longitudinal and the dorso-ventral muscles. The longitudinal muscles are very similar to those of the Lernaeopodidae, with certain minor variations. On the dorsal surface there are four bands of muscle, two on either side of the median line, running the entire length of the body from the base of the dorsal cephalothoracic processes to the anterior margin of the abdomen. In *Paeon ferox* and in *Sphyrion* and *Rebelula* the two inner bands are separated a little in the trunk, leaving an open space along the median line over the intestine. In *Paeon versicolor* they remain close together, but the two outer bands are removed nearly or quite to the lateral margin of the trunk.

On the ventral surface are four wide bands, two on either side, which run similarly from the base of the maxillipeds to the anterior margin of the abdomen. All four of these remain close together throughout their entire length in *Paeon versicolor* and in *Sphyrion* and *Rebelula*, but in *Paeon ferox* the two outer ones are removed to the lateral margins of the trunk. Consequently in *Paeon ferox* there are two median dorsal bands separated by a narrow interval, two median ventral bands and two bands on each lateral margin of the trunk. In *Paeon versicolor* there are two median dorsal bands, not separated, two lateral dorsal bands, one on each side, and four median ventral bands. In the other genera there are four median dorsal bands, separated a little along the midline, and four median ventral bands.

In *Paeon* all these muscles show distinct breaks at the dividing lines between the body segments and enable us to determine what part each segment has taken in the body elongation. A similar break in the median dorsal muscles just before reaching the base of the anal laminae shows that an abdomen is really present, even though it be reduced almost to nothing and so thoroughly fused with the genital segment as to be otherwise indistinguishable. The posterior processes in the young *Sphyrion* (fig. 20) are manifestly attached to the abdomen. The base of the posterior processes in *Paeon* being posterior to the muscle break, they must also be regarded as abdominal.

The second set of muscles, which are dorso-ventral, have no counterpart in any of the other copepod families. They consist of individual muscle strands either scattered uniformly over the entire area between the intestine and the lateral walls of the trunk (*Paeon*, *Sphyrion*), or gathered into bundles in restricted areas (*Rebelula*, *Periplexis*). When scattered the individual strands are not usually vertical, but are inclined a little in one direction or another. Between these strands are woven the coils of the oviducts and by their contraction the muscles undoubtedly aid the passage of the eggs along the oviducts. A simultaneous contraction of all the muscles produces a depression of the dorsal and ventral surfaces of the trunk over the area covered by the muscles. In the case of the restricted areas such contraction produces pits symmetrically arranged and corresponding in position on the dorsal and ventral surfaces. There are the usual muscles connected with the vulvae and assisting in the extrusion of the eggs into the egg strings.

Muscular system of the male.—The musculature of the male is well shown in figure 59, which is a side view of the male of *Paeon ferox*. The muscles of the cephalothorax are connected entirely with the antennae and mouth parts, and every appendage except the first maxillae is well supplied. The muscles of the second maxillae and maxillipeds are especially numerous and powerful and must make of those appendages very efficient prehensile organs. In the thorax there are simply the usual muscles between the segments on the dorsal and ventral surfaces, which produce flexion and extension. In the fused posterior portion, or trunk, there is in addition a strong diagonal muscle on either side which aids in extruding the spermatophores.

Alimentary canal.—The mouth opens into a short esophagus, which is usually inclined dorsally and fairly straight, but in *Rebe-*

lula it takes on more or less of an S curve. It opens into the stomach at the anteroventral margin of the latter, the opening being surrounded by a rather weak sphincter muscle. The mouth tube is not sufficiently protrusible in any species of this family to affect the esophagus at all. The stomach is abruptly enlarged behind the sphincter and shows neither convolutions or processes in any of the species examined. It is lined with digestive epithelium similar in all respects to that found in other families. It passes insensibly into the intestine which is rapidly narrowed into a mere thread on entering the neck, and which shows neither convolutions nor foldings. The intestine is widened again on emerging from the neck, passes nearer to the dorsal surface of the trunk, and is contracted again into a relatively large and barrel-shaped rectum. The latter evidently functions as an effective organ of respiration in developmental stages, and is operated by a set of dilator muscles on either side. But after the development of the posterior processes this function is shifted to them, and although the rectum persists and increases in size, it simply serves for the expulsion of the excreta.

The intestine is smooth and unmodified in *Paeon*, but in *Sphyrion* and *Rebelula* it becomes remarkably changed by the development of lateral and dorsal processes. The wall of the intestine bulges out in two rows of small knobs along either side, one dorsal and one ventral, and one row along the center of the dorsal surface (fig. 30). These knobs gradually elongate until the ends of those in the three dorsal rows reach the dorsal wall of the trunk, against whose inner surface they flatten out (fig. 31). The two ventrolateral rows grow laterally more than ventrally, until they reach and flatten out against the dorsoventral muscle strands.

The inner cavity of all the processes remains in full communication with the lumen of the intestine. The dorsolateral processes reach the dorsal wall of the trunk just inside of the dorsoventral muscles, while the dorsocentral processes flatten out between the longitudinal bands of muscle.

Subsequently in *Sphyrion* all the processes elongate laterally until on the dorsal surface they fill almost the entire median space between the two sets of dorsoventral muscles, with only a very narrow sinus on either side beneath the longitudinal muscles and between the central and the lateral row. On the ventral side they crowd out into the dorsoventral muscles and grow inward around the intestine, until they almost meet on the midline, presenting the appearance seen in figure 32.

The intestine, together with these five rows of processes, fills practically all the lumen of the trunk between the dorsoventral muscles, the only vacant space being below the center of the intestine, between the ventral rows of processes. All the processes are shorter and smaller anteriorly and posteriorly, and wider and larger along the center; they stop posteriorly at the contraction between the intestine and the rectum, and anteriorly at an equal distance from the anterior end of the trunk.

In *Rebelula* the system of processes begins at the junction of the neck and trunk and ends just behind the longitudinal center of the trunk. In this genus the anterior processes grow much more rapidly than the posterior and branch profusely. They thus come to fill the entire lumen of the trunk from wall to wall for about one-fourth of its length, the ends of the branches flattening against the inner surface of the wall on all sides. They then diminish rapidly laterally but still reach the dorsal and ventral body wall. The combined mass assumes something of a triangular outline, widest anteriorly and narrowing to a point posteriorly.

The branching of the processes destroys the appearance of being in rows, and makes the mass look far more like a bunch of grapes than is the case with the posterior processes of *Sphyrion*. Cornalia discovered this mass of processes in his "*Lophoura edwardsii*," but mistaking the nature of the intestine he called them blind appendages of the stomach.

He only represented them along the anterior margin, however, and did not see that they extended as well over the entire surface of the anterior trunk.

NERVOUS SYSTEM.

We know nothing about the nervous system in any of the larval stages, but in the matured adult it is practically the same as in the Lernaeidae. There is, however, one important difference. In every Lernaean genus the tripartite eye of the larva persists in the adult, buried deeply in the tissues over the base of the esophagus, but still easily recognized in cleared specimens. In the present [illegible] the eye is entirely lacking and there is no trace of it in any [illegible] remains of the two esophageal ganglia can still be seen [illegible] and the beginning of the ventral nerve cord. But no nerves [illegible] found in the neck or trunk either in sections or in cleared specime[illegible] Such nerves must exist, however, to control the various trunk muscles, especially those connected with the passage of the eggs along the oviducts and their extrusion into the external egg sacks.

REPRODUCTIVE SYSTEM.

Male reproductive organs.—These consist of a pair of testes situated in the posterior part of the head, a pair of nearly straight *vasa deferentia*, each surrounded for a portion of its length by a cement gland, and a pair of spermatophore receptacles. The testes are dorsal to the stomach and intestine, and are so large in *Rebelulu* that they cause the posterior portion of the head to bulge out dorsally into two hemispherical knobs. The *vasa deferentia* are given off from the posterior ends of the testes and run back nearly in a straight line along either side of the body to the dorsal portion of the genital segment, where they turn down ventrally and are enlarged into spermatophore receptacles. For a considerable portion of its passage along the side of the body each *vas deferens* is surrounded by a mass of glandular tissue which secretes and pours into the lumen of the sperm duct the cement substance, which hardens into the covering of the spermatophore. The opening through which the spermatophore is extruded is on the ventral surface, just in front of the posterior processes.

Female reproductive organs.—The ovaries are paired, and are situated either along the lateral margin of the anterior portion of the trunk (*Sphyrion*), or just inside and in front of the cement glands (*Paeon*, *Rebelula*). They are nearer the dorsal than the ventral surface, and are slightly flattened against the lateral wall. Each ovary consists of a mass of tiny cells, with no arrangement into filaments, but with all the eggs separate and in close contact one with another. But there is not the uniform gradation in size from one end of the ovary to the other that was found in the Lernaeidae. The eggs increase rapidly in size as soon as they leave the ovary through the absorption of food material and yolk. They are arranged in the oviduct in a single row, and retain perfectly their spherical shape. Occasionally they become flattened a little through crowding, especially around the turns of the oviduct, but they are never compressed into disks.

The oviducts are narrow and thread-like and are coiled back and forth laterally between the dorsoventral muscle strands without any definite arrangement. Apparently they first fill the space at the posterior portion of the genital segment between the cement glands and the intestine, and then extend forward into the central portion of the trunk which represents the fifth thoracic segment, and may even reach in *Paeon* and *Sphyrion* the extreme anterior end of the trunk, the fourth thorax segment.

In *Rebelula* they are prevented from doing this by the branched intestinal processes and occupy only the triangular space on either side behind those processes. The sperm receptacle is situated at the posterior end of the genital segment, on the median line between the two vulvae, and ventral to the intestine. The cement glands are in the postero-lateral portions of the genital segment and follow the contour of the body wall. The glandular portion is long and narrow except in *Paeon versicolor*, where it is short and thick. It lies a little nearer the ventral surface and is usually curved inward a little at the extreme anterior end. The whole gland is also concave inwardly, the two assuming the form of parenthesis marks. The glandular portion does not show segmentation in any genus, but in preservatives the cement substance through the center of the gland usually breaks up into thin disk-like laminae, arranged like a row of coins. The duct is short and filose and enters the oviduct just inside the vulva. The external egg sacks are long and straight, usually uniform in diameter, or only slightly narrowed posteriorly and bluntly rounded at the end. The eggs are packed into them rather loosely and without any definite arrangement in rows.

And of course the developing larvae are not arranged in any definite relation to the outer walls of the sack. The eggs are very numerous in all the genera but especially so in *Rebelula*, where the number often reaches into the thousands. Nothing is known of the shape or size of the spermatophores since none were present in any of the females thus far examined.

SYSTEMATIC PART.

SPHYRIIDAE, new family.

External family characters of female.—Body divided into three distinct regions, a soft cephalothorax, a slender neck, chitinous and armed with processes or horns at its junction with the cephalothorax except in *Opimia*, and a trunk, flattened dorsoventrally and usually with pits or depressions on its dorsal and ventral surfaces. Abdomen minute and thoroughly fused with the genital segment in young females, much reduced or practically lacking in the adult, but the anal laminae always present. One pair of posterior processes; egg strings long and cylindrical, eggs multiseriate.

Two pairs of antennae in young stages, second pair chelate; a more or less protrusible proboscis; two pairs of maxillae, second pair uncinate; one pair of maxillipeds also uncinate.

Internal family characters of female.—Body cavity extending into the processes of the cephalothorax and the posterior processes of the abdomen. Digestive tube extending through the center of the body, nearer the dorsal surface in the trunk, without convolutions but profusely covered with processes in *Sphyrion* and *Rebelula*. Ovaries paired, situated close to the lateral walls of the trunk; oviducts profusely coiled, coils separated by dorsoventral strands of muscle either universally distributed or gathered in bunches; cement glands at the posterior corners of the genital segment, usually without joints. Chitinogen layer well developed, especially at the posterior corners of the genital segment, in the cephalothoracic and posterior processes, and in the respiratory cylinders.

External family characters of male.—Body folded upon itself and unsegmented in *Sphyrion*, straight or curved and more or less segmented in the other genera; made up of two regions, a cephalothorax, bearing the antennae and mouth parts, and a thorax destitute of appendages. Two pairs of antennae, second pair chelate; proboscis long and retractile like those of the Lernaeopodinae. First maxillae biramose, second pair one-jointed, uncinate; maxillipeds with fused basal joints, terminal joints free, uncinate.

Internal family characters of male.—Digestive tube extending straight through the body, nearer the ventral surface. Testes paired in the posterior dorsal portion of the cephalothorax, often protruding strongly as spherical swellings; sperm ducts lateral, not convoluted but surrounded by large cement glands; sphermatophore receptacles in the genital segment. A large frontal gland above the anterior end of the stomach; a large fused maxillipedal gland in the basal joints of the maxillipeds; smaller glands in the first and third thorax segments and near the anus.

Remarks.—This family is at once distinguished from the Lernaeidae by the presence of adult pigmy males attached to the females, while in the Lernaeidae the males do not pass beyond the fourth copepodid stage and are never found with the adult females. The Sphyriidae also differ in the position and arrangement of the reproductive organs and in the presence of dorsoventral muscles, separating the convolutions of the oviducts and forming by their contraction pits or grooves on the dorsal and ventral surfaces of the trunk. Still another difference is found in the complicated system of processes attached to the itestine in the trunk of *Sphyrion* and *Rebelula*, which has no counterpart in the Lernaeidae.

In the elongation of the body of the female previous to and during burrowing all the thoracic segments take a part, the third and fourth segments being elongated the most. The trunk is composed of a part of the fourth and all of the fifth and sixth segments while in the Lernaeidae this is true only of the genus *Lernaea* (*Lernaeocera*). And in that genus the arrangement and position of the reproductive organs is like that of the other Lernaeans and radically different from the present family.

The males of the Sphyriidae closely resemble those of the Lernaeopodidae, particularly the genera *Achtheres*, *Salmincola*, *Lernaeopoda*, and *Clavellisa*, but the females bear no resemblance whatever, lacking the peculiar second maxillae, having lateral processes or horns on the cephalothorax, and burying the head and neck in the tissues of the host.

From the Chondracanthidae, with which family some of the present genera have at times been placed, the females differ in the absence of prehensile second antennae and thoracic legs and in the presence of lateral processes on the cephalothorax, in the long slender neck, and in the posterior processes on the abdomen. The males differ in the entire absence of swimming legs, in the fusion of the basal joints of the maxillipeds, and in the structure of the antennae and mouth parts. The family is thus clearly differentiated from all the other copepod families and occupies a place peculiarly its own, its males closely resembling those of the Lernaeopodidae and its females bearing some external resemblance to those of the Lernaeidae.

ARTIFICIAL KEY TO THE GENERA.

1. Posterior processes cylindrical, smooth, and divided into large lobes; neck bent and twisted and armed with numerous chitin horns. *Periplexis*, new genus, p. 598.

1. Posterior processes cylindrical, smooth, neither lobed nor divided; neck straight and smooth, no chitin horns-------------------------- 2.

1. Posterior processes covered with gill cones or cylinders; neck straight and smooth, with horns or processes---------------------------------- 3.

2. Cephalothorax orbicular, without processes; neck stout and flattened. *Opimia* Wilson, 1908, p. 589.

2. Cephalothorax transversely ellipsoidal, with three pairs of prominent processes; neck slender and cylindrical-------------*Paeon*, new genus, p. 590.

2. Cephalothorax orbicular, furnished with cartilaginous horns; neck slender and cylindrical--------------------*Trypaphylum* Richiardi, 1878, p. 588.

3. Cephalothorax a narrow cylinder, with small lateral processes or horns; neck filose--------------------------------------*Rebelula* Poche, 1905, p. 576.

3. Cephalothorax short and very wide, much flattened, with enormous lateral processes, often lobed; neck thick and stout--*Sphyrion* Cuvier, 1839, p. 566.

Genus SPHYRION Cuvier.

Chondracanthus Quoy and Gaimard, Freycinet's Voyage autour du Monde, 1824, Zoologie, Atlas, pl. 86, fig. 10. "Chondracanthe lisse."

Sphyrion Cuvier, Le Règne Animal, 1830, vol. 3, p. 257. "Sphyrion lisse."

Sphyrion Guérin-Meneville, Iconographie du Règne Animal, 1829–1843, vol. 2, p. 11, pl. 9, fig. 4. *Sphyrion laevigatus*.

Sphyrion Milne Edwards, Histoire Naturelle des Crustacès, 1840, vol. 3, p. 525.

Lestes Krøyer, Danmarks Fiske, 1845, vol. 2, p. 517.

Sphyrion Steenstrup and Lütken, Kong. Danske Videns. Selskab. Skrifter, 1861, ser. 5, vol. 5, pp. 347 and 432.

Lesteira Krøyer, Naturhistorisk Tidsskrift, 1863, ser. 3, vol. 2, p. 402.

Lesteira Heller, Reise der *Novara*, 1865, Crustacea, p. 228.

Lesteira G. M. Thomson, Trans. New Zealand Inst., 1890, vol. 22, p. 370.

Sphyrion Bassett-Smith, Proc. Zool. Soc. London, 1899, pp. 441 and 488.

Sphyrion Stebbing, Cape of Good Hope, Dept. Agric., South African Crustacea, *Sphyrion laevigatum*, p. 60, pl. 4, 1900.

Sphyrion Thor, Ann. Sci. Nat., ser. 8, 1900, vol. 11, p. 277. *Sphyrion australicus*, new species, p. 280.

Sphyrion Quidor, Archiv. Zool. expér. et gen., ser. 5, 1912, vol. 10, p. xxxix, *Sphyrion delagei*, new species, p. xii; *stewarti*, new species, p. xiii.

Sphyrion T. and A. Scott, British Parisitic Copedoda, 1913, vol. 1, p. 164.

External generic characters of female.—Cephalothorax transsely expanded into a pair of enormous soft processes of varying shape, forming the sphyra or hammer, from the center of whose anterior surface projects the head. Neck smooth, of medium diameter and often enlarged posteriorly. Trunk greatly enlarged transversely, flattened dorsoventrally, smooth or pitted according to the contraction of the dorsoventral muscles; no abdomen but a pair of knob-like anal laminae. A pair of posterior processes profusely and dichotomously branched; egg strings long and straight; eggs multiseriate. In young females two pairs of antennae, two pairs of maxillae, one pair of maxillipeds, no swimming legs. In older females the appendages degenerate into knobs or entirely disappear.

Internal generic characters of female.—Mouth tube at the extreme anterior margin of the head, inclined ventrally; esophagus entering the stomach on the anteroventral surface; stomach without lateral processes; intestine narrowed in the neck and widened in the trunk, where it develops a complicated system of processes; rectum short, opening between the anal laminae; cement glands strongly curved, close to the posterolateral walls of the genital segment, indistinctly jointed; ovaries close to the body wall on either side and reaching from the anterior end of the trunk to the anterior end of the cement glands; oviducts profusely coiled, the convolutions separated by strands of dorsoventral muscles; chitinogen layer thickest in the anterior part of the trunk, outside of the oviduct coils.

External generic characters of male.—General form an elongated ellipsoid, with the cephalothorax attached to one end on a level with the dorsal surface and covered with a minute carapace. Body folded upon itself very much as in the Lernaeopod genus *Clavellisa* and thoroughly fused, without distinction of parts or segmentation; mouth tube, appendages, and a genital process on the ventral surface. Two pairs of antennae on the anterior margin of the tiny carapace; two pairs of maxillae; maxillipeds slender and chelate, their basal joints fused.

Internal generic characters of male.—Esophagus not much inclined to the body axis, but quite long and entering the stomach at the anterior end. Stomach close to the dorsal surface of the head, passing insensibly into the intestine which follows around the curve of the body, and then turns forward and opens at the anus just behind the maxillipeds. Testes paired, between the stomach-intestine and the dorsal wall of the head, opposite the bases of the maxillipeds; sperm duct coiled backward and forward twice between the intestine and the lateral body wall, the last time forming a fairly large spermatophore receptacle.

Type of the genus.—*Sphyrion laevigatum* Guèrin Meneville. (*Sphyrion*, σφυρίον, a little hammer.)

ARTIFICIAL KEY TO THE SPECIES.

Cephalothorax (hammer) only half wider than long and smooth; neck without processes, longer than the rest of the body combined; genital segment longer than wide____________________________________*lumpi* (Krøyer), 1837, p. 570.

Cephalothorax (hammer) two or three times as wide as long and covered with soft processes, often branched; neck shorter than genital segment; the latter wider than long__________________*laevigatum* Guèrin-Meneville, 1839, p. 575.

Remarks.—From the series of developmental stages here presented it can be easily seen that the body dimensions will vary greatly with the growth. The hammer tends to become more and more elongated transversely; its surface remains smooth and unbroken in *lumpi*, while in *laevigatum* it becomes broken into numerous processes and warts. Once this latter sort of growth is begun it is manifest that there will be no limit either in the number or the pattern of the excrescences. The antennae and mouth parts alone will show any regularity of position, size, or shape.

Furthermore the same individual will show a very different pattern of cephalothorax at different stages in its growth. And probably no two individuals of the same species will ever be just alike.

The neck varies greatly in length, in actual diameter, and in relative diameter at its anterior and posterior ends. In general, the older and the larger the parasite becomes, the smaller is the neck diameter in comparison with the other body regions. The trunk changes the least of any part of the body, but even it must become considerably swollen with the maturation of the eggs and shrunken after their extrusion into the external sacks. On the other hand, there is the greatest chance for variation in the posterior processes. They start as simple branches at the point of fusion of the anal laminae with the genital segment, and become more and more complexly branched with growth. As in shrubs and trees, therefore, we must not expect to find exact duplicates of any particular pattern, but only a general similarity in the mode of branching.

In the same way we might well find the tips of the branches swollen into spheres in one specimen, normally cylindrical in another, and flattened in a third. Such considerations as these make any differentiation of species upon the external characters of the female alone very questionable. The best, and probably the only reliable, method of separating species will be by comparison of the males and young females whose mouth parts have not yet become degenerate.

Seven species of the genus have been thus far proposed, but a careful comparison of the descriptions given, which are based entirely upon the external appearance of the female, apparently reduces the species to the two given above. Since most of the descriptions place considerable emphasis upon size, a table of the comparative sizes of the seven species is here given. The figures are millimeters.

Species.	Hammer.		Neck.		Trunk.		Egg strings.	
	Length.	Width.	Length.	Width.	Length.	Width.	Length.	Width.
lumpi..................	13–16	10	15–35	2.5	12–16	12	20	2.5
laevigatum............	15–60	4–20	7–12	1–3.5	9–20	9–28	26	2
australicus...........	20	2–8	7	1–2	10–12	15	30	2.5
delagei................	25	11	7	1–2	9	15	20	2.5
stewarti...............	....	....	10	5	12	14	30	2
kingi..................	21	7	4	1.5	14	17	37	2
krøyeri................	54	10	12	1–3.5	11	18	25	2

The length of the hammer is transverse to the body axis.

The first two species in the table are conceded to be distinct, and it will be noted that the variations given for the second species, *laevigatum*, are amply sufficient in range to cover the five following species, but it will be interesting to note these species in detail.

SPHYRION AUSTRALICUS Thor.

This species has a more robust structure than *laevigatum*, the egg strings are a little longer, and the hammer has long digitiform processes which Thor regarded as transformed legs. The neck is strongly curved and twisted until the hammer is at right angles to the trunk. The posterior processes are the same size and shape as in *laevigatum* but are perhaps a little less branched. This parasite was reported to have been taken from "la grande morue rouge d'Australie" although there is no cod known from Australia that is large and red.

Obviously there is not enough in this description to render the species valid and it must be considered a synonym of *laevigatum*.

SPHYRION DELAGEI Quidor.

The hammer is longer and narrower than in *australicus*, and the protuberances which it carries are smaller. The neck and trunk are bent to the left and the neck shows a direct torsion of 90°. The processes of the hammer are more or less regular and probably represent modified appendages. The trunk has the form of an ellipse, much wider than long; the abdomen is reduced and carries on its ventral surface two bunches of chitin appendages, whose branching is analogous to that in *australicus*, but whose tips are spherical instead of being flattened. The species is based on a single specimen taken from behind the dorsal fin of a cod in the Sandwich Islands. Here again there is nothing to constitute a specific difference and the species must be regarded as a synonym of *laevigatum*.

SPHYRION STEWARTI Quidor.

The hammer is entirely lacking and the host is unknown, but the single specimen came from New Zealand. That part of the neck which remains is considerably wider than in any other reported specimen; the trunk is quadrangular and flattened, and the abdomen is distinctly visible. The posterior processes are branched dichotomously and the branches are perpendicular to the surface of the bunch, and their swollen tips are the only things visible. Such slight differences are hardly enough to constitute a valid species based on a single mutilated specimen.

SPHYRION KINGI Cunningham.

In his Notes on the Crustacea obtained during the voyage of H.M.S. *Nassau* Cunningham[1] published this new species. He gave no description, but merely said that it differed from *laevigatum* "in the greater width of the sucking disk (hammer) and of the body, as well as in various other points which will be readily understood by a comparison of the figures of *laevigatum* and *kingi*." The figure he gave, however, showed no details save those of the relative shape and size of different parts of the body, and they are not enough to establish his species.

SPHYRION KRØYERI (Thomson).

Thomson referred this species to Krøyer's genus *Lesteira;* it differs from other species chiefly in the shape of the hammer, whose transverse diameter is greater than the entire length of the body. The neck and trunk are hard and horny, and the bunches of posterior appendages are as long as the trunk itself. Taken from the abdomen of a ling, *Genypterus blacodes*, near New Zealand. Here again the species rests for its validity almost entirely upon the shape of the hammer, and can not be accepted without further proof.

SPHYRION LUMPI (Krøyer).

Plates 50, 51, and 52.

Lestes lumpi Krøyer, Danmarks Fiske, vol. 2, 1845, p. 517.

Lesteira lumpi Krøyer, Naturhist. Tidsskdift, ser. 3, vol. 2, p. 325, pl. 18, fig. 5, 1863.

Lesteira lumpi Steenstrup, Overs. Kongel. Danske Vidensk. Selsk. Forhandl., 1869, no. 3, p. 182, pl. 2, figs. 4 and 5.

Sphyrion lumpi Bassett-Smith, Proc. Zool. Soc. London, 1899, p. 489.

Sphyrion lumpi T. and A. Scott, British Parasitic Copepoda, 1913, p. 164, pl. 51, figs. 3 and 4.

Host and record of specimens.—The United States National Museum contains the following specimens: A single female (Cat. No. 42342, U.S.N.M.), from a salted hake; a single female (Cat. No.

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[1] In Trans. Linn. Soc. London, vol. 27, 1871, p. 501.

49759, U.S.N.M), from *Sebastes marinus* taken off Cape Cod in 1879; a single female with attached male (Cat. No. 49760, U.S.N.M), from *Nematonurus goodei* taken off the New Jersey coast by the *Albatross* in 1884; four immature females (Cat. No. 49761, U.S.N.M), from the same host and locality in 1885; a single female, lacking the hammer, from *Haloporphyrus viola*, cleared to show the internal anatomy.

Specific characters of female.—Cephalothorax enlarged by lateral processes until it is usually a little wider than the genital segment. In young females and in some mature ones the outer ends of the processes are bluntly pointed, giving the hammer a transversely elliptical outline, with rather pointed ends. In other specimens the ends of the processes are enlarged into knobs and one or both of the knobs may be bifid, giving the creature much more of a hammer shape. Owing to torsion the transverse diameter of the head in matured females is usually at right angles to that of the trunk. Krøyer, who founded the species, claimed that this enlarged portion was the head alone, but most of the other observers have called it a cephalothorax, which it is now definitely proved to be by the presence of swimming legs in immature specimens. This cephalothorax is followed by a narrow neck of varying length, but fully as long in the young females as in the older ones. Then comes an enlarged trunk made up chiefly of the genital segment, which is more or less heart-shaped and strongly flattened dorsoventrally. To it are attached a pair of anal laminae and a pair of posterior processes, simple at first but becoming more and more profusely branched as the animal matures.

In the youngest specimen obtained (fig. 15.) the lateral lobes of the cephalothorax are small, not pointed, and plainly thoracic in origin; the head projects from the ventral surface and is scarcely visible in dorsal view. The walls of the entire body are of equal thickness and perfectly transparent like glass; the neck is very slender but is 25 mm. in length and of uniform width; the trunk is an elongated oval, five times the diameter of the neck; the abdomen is fused with the genital segment, but is well differentiated by breaks in the musculature and by lateral sinuses at its base; the posterior processes arise from its dorsal surface and are simple and unbranched, but somewhat flattened dorsoventrally.

Inside of the trunk the filiform intestine increases gradually in diameter and is then contracted again into a barrel-shaped rectum about one-fourth the distance from the posterior end. Along the enlarged portion can be seen the beginnings of the intestinal processes, which assume the form of two rows of small knobs on either side, one dorsal and the other ventral, and a single row along the center of the dorsal surface.

The cement glands and ovaries may be distinguished near the lateral walls of the trunk, but as yet they are only partially developed.

In an older specimen (fig. 18) the lateral processes of the cephalothorax are more pointed and relatively larger, the head has moved to the anterior margin and is plainly visible dorsally as well as ventrally; the neck and trunk have enlarged relatively in diameter and the posterior processes have elongated considerably, are much twisted, and have begun to branch. This specimen shows the antennae and mouth parts admirably, and it will be well to describe them in detail. The first antennae are three-jointed processes projecting from the anterior margin of the head near the center, just above and inside of the second pair. The basal joint is much the largest and the terminal joint is a minute knob on the tip of the second joint near its inner margin; these antennae are destitute of spines or setae. The second antennae are three-jointed, the basal joint much the largest; they start from the anterolateral corners of the head and curve diagonally inward and backward across the face, almost meeting on the midline. On the tip of the terminal joint are two processes arranged like a chela, one dorsal and the other ventral and a little lateral. Between these antennae lies the mouth tube which is conical and inclined forward and downward. On either side of the tube is a short process or knob, the first maxilla, tipped with a tiny spine. Posterior to the tube is the second pair of maxillae, each of which is a one-jointed, fingerlike process, with a small claw on its tip.

A short distance behind these is a pair of large fleshy processes, which stand out prominently from the ventral surface of the head; their adjacent surfaces are flattened together and fused on the midline so that the two form a hemisphere whose posterior surface, away from the mouth, is divided by a shallow median groove. On this posterior surface at the bases of the processes, where they easily escape notice, is a pair of one-jointed maxillipeds. Each consists of a swollen joint, pointed at the tip and armed with a stout and strongly curved claw and a long spine on the inner margin (fig. 10). These are so overshadowed by the large padlike processes in front of them that they can not be of any service to the matured female, but they probably assist it in securing its first hold upon its host, and in boring its way through the skin into the underlying tissues. A short distance behind the maxillipeds are the bases of the first swimming legs as is shown by the usual chitin ridge on the surface and by muscles beneath the skin. The legs themselves are broken off, but Rathbun obtained one of them and has given an excellent drawing of it. The basal joint is ovate and at the tip are two minute one-jointed rami, without spines or setae. There was a second pair of legs opposite the posterior margin of the lateral processes, but no traces of any others.

Inside the trunk (Fig. 31) considerable development has taken place; the five rows of intestinal processes are now very much in evidence and fill a large portion of the body cavity. Each of the lateral rows extends out obliquely from the surface of the intestine; the dorsal ones reach the dorsal body wall about halfway between the midline and the lateral margin, just inside the dorsoventral muscles, but the ventral ones do not reach the ventral wall. Instead they are more nearly horizontal and extend against the sides of the muscles, in some cases pushing a short distance between them. The dorsal row extend vertically upward and reach the dorsal wall of the trunk along the midline. There are thus two narrow spaces between the rows dorsally and a wide ventral space that is partially filled with spongy chitinogen tissue. The intestine still presents its general outline and all the processes stop before reaching the rectum. The ovaries and cement glands have also developed considerably and are plainly visible along the lateral margins, with quite an interval between them at the center.

The color of immature specimens is snowy white, becoming brownish as the female matures, and this brown is much deepened in preservatives. Measurements are given of two adults since they differ in details; the first figures given belong to the specimen shown in figure 1, the second to the specimen whose head is shown in figure 13, and which evidently resembled one of Krøyer's figures.

Total length, including posterior processes, 60–45 mm. Length of cephalothorax, 10–10 mm.; width 13–16.50 mm. Length of neck, 35–15 mm. Length of trunk, 16–12 mm.; width, 10–15 mm.; thickness, 6–5 mm. Length of posterior processes, 8–16 mm. Length of egg strings, 20–20 mm. The second specimen thus has a wider cephalothorax, a shorter neck, a shorter but wider trunk, and longer posterior processes.

As the females mature all the body regions thicken and the posterior processes become more and more profusely branched. A third stage of the latter is shown in figure 7, and the matured female is seen in figures 1 and 2.

From the above measurements it will be seen that one of the adults had processes fully twice the size of those on the other specimen. The internal anatomy of the matured trunk is shown in ventral view in figure 32. The intestine is considerably increased in diameter, and is nearer the dorsal surface of the trunk. On either side of it lies the long ventral row of processes, reaching nearly the whole length of the trunk and narrowed at either end. Here and there, especially toward the posterior end, a process is found which does not reach the whole width of the row, and then the adjacent processes on either side of it come together for the remainder of the distance. The processes h
also grown inward over the ventral surface of the intestine and do

ward until they reach the ventral body wall. Dorsal to the intestine the processes have also widened, but there is still a space on either side between the rows.

The ovaries now reach back to the anterior ends of the cement glands, and the oviducts are apparently given off from their posterior ends. These oviducts are coiled to the right and left in the space between the ovary (anteriorly) and the cement glands (posteriorly), and the intestinal processes on either side, and the coils are separated by strands of dorsoventral muscles, whose contraction helps to pass the eggs along the oviducts. The eggs are separate, and although in places they are close enough together to become somewhat flattened, they are never crowded. They finally issue into the external sacks at the posterior end of the genital segment, close to the median line. The cement glands are at the extreme posterolateral margin of the trunk, close to the body wall. They are long and slender and curved into the form of a parenthesis mark; they do not show regular segmentation; the ducts from these glands are short and threadlike and enter the oviduct just inside the vulva.

Specific characters of male.—In addition to the generic characters already given we may add that the basal joint of the first antennae is much the largest, the second and third joints are about the same size, and the terminal joint is tipped with two stout spines. The basal joint of the second antennae is twice as wide as long and unarmed, the second joint is the same width and length as the basal one, with a short spine at the outer anterior corner and on the inner margin a wide process armed with three stout spines; terminal joint half the width and length of the second joint and tipped with three stout spines. Second maxillae, two-jointed, joints stout and swollen, the basal one the larger, the terminal one tipped with a strong, bluntly pointed claw, bent into a half circle; on the inner margin of the joint near the tip is a short and stout spine. Basal joints of the maxillipeds fused across the midline; terminal joints rather slender and tipped with a chela, a strong claw on the anterior corner shutting down into a sheath on the opposite margin.

Color (preserved material) a uniform yellowish white. Total length, 2 mm.; width, 1 mm.; greatest thickness, 0.50 mm.

(*lumpi*, the specific name of the original host).

Newly hatched larva.—The present author has never seen the larva, but Krøyer gave two figures[1] which he designated "Pullus ex ovo productus," and which show several interesting features. The dorsal view looks somewhat like a nauplius, but lacks the balancers at the posterior end of the body; the side view shows unmistakably that it is not a nauplius, but a much more advanced larva. The first antennae are distinctly three-jointed, and in addition to the other two pairs of nauplius appendages there are three pairs of mouth parts, two pairs of swimming legs, and the rudiments of an abdomen. This shows at least that the larva does not issue from the egg as a nauplius, like the Lernaeidae, but that it passes the nauplius and metanauplius stages inside the egg and comes forth in one of the copepodid stages like the Lernaeopodidae. Such a larval development separates the present family so much the more distinctly from the Lernaeidae.

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[1] Naturhistorisk Tidsskrift, ser. 3, vol. 2, pl. 18, fig. 5, *f* and *g*.

Remarks.—Some doubt has been expressed by Stebbing and others whether Krøyer's species was distinct from *laevigatum.* The finding of the male and the appendages of the female, with the details here given, will serve to strengthen its validity. The female may be recognized by the prominent head projecting from the anterior margin of the cephalothorax by the general shape of the latter, and by the details of the appendages.

SPHYRION LAEVIGATUM Guérin-Meneville.

Chondracanthe lisse Quoy and Gaimard, Freycinet's Voyage, 1824, Zoologie, Atlas, pl. 86, fig. 10.

Sphyrion lisse Cuvier, Le Règne Animal, 1830, vol. 3, p. 257.

Sphyrion laevigatus Guérin-Meneville, Iconographie Zoophytes, p. 11, pl. 9, fig. 4.—Milne Edwards, Histoire Naturelle des Crustacés, 1840, vol. 3, p. 526.—Cuvier, Le Règne Animal, edition illustrée, Zoophytes, p. 62–63, pl. 32, figs. 4 and 4*a*.

Sphyrion laevis Steenstrup, Oversigt Vidensk. Selsk. Kjöbenhavn, 1869, p. 202, pl. 2, figs. 4*a* and 4*b*.—Thor. Ann. Sci. Nat., 1900, ser. 8, vol. 11, p. 278, pl. 17, figs. 1, 2, 4, 7–9; pl. 18, figs. 3, 5, 6, 14.

Lesteira krøyeri Thompson, Trans. New Zealand Inst., 1890, vol. 22, p. 370, pl. 28, figs. 4 and 4*a*.

Sphyrion laevigatum Stebbing, Cape of Good Hope, Dept. Agriculture, 1900, p. 60, pl. 4.—Quidor, Archiv. Zool. expér. et gen., 1912, ser. 5, vol. 10, p. xi, 1 text fig.—Brian, Bull. Inst. Oceanog., 1917, no. 324, p. 3, 2 text figs.

Sphyrion australicus (?) Thor, Ann. Sci. Nat., ser. 8, vol. 11, 1900, p. 280.

Sphyrion delagei (?) Quidor, Archiv. Zool. expér. et gen., 1912, ser. 5, vol. 10, p. xii.

Sphyrion stewarti (?) Quidor, Archiv. Zool. expér. et gen., 1912, ser. 5, vol. 10, p. xiii.

Sphyrion kingi (?) Cunningham, Trans. Linn. Soc. London, vol. 27, 1871, p. 501.

The following description is adapted from Thor, 1900, cited above. The cephalothorax (hammer) is 14–15 mm. long (transversely), 4–6 mm. wide, and 3–4 mm. thick. On the ventral surface at the anterior margin are two large recurved processes, which Krøyer interpreted in *lumpi* as anterior antennae, but which Thor suggests may be mandibles (?). On the dorsal surface beneath the skin are a pair of small hooks, regarded as rudimentary antennae. Near the mouth on the ventral surface are two large papillae and two much smaller ones, regarded as rudimentary mouth parts. The ends of the hammer are wart-like and there are small protuberances on the dorsal and ventral surfaces regarded as rudimentary legs (?). The neck has a length of 7–8 mm. and a diameter of 1–2.5 mm., the narrowest portion being next to the hammer and the posterior portion being much broader. The trunk or genital segment has the form of a disk, almost semicircular, thickened along the midline and around the margins, but sunken in the spaces between. The posterior margin is enlarged at the center into a prominent abdomen, completely fused with the trunk. The egg strings are 25–30 mm. long and 1–2 mm. in diameter; the branched posterior processes are almost 10 mm. long, and project beyond the lateral margins of the trunk on either side. There is great variation in the size of the hammer as well as in the processes and papillae which project from it.

Remarks.—By comparing this description with that previously given for *lumpi* it will be seen that the protuberances on the hammer are not to be interpreted as appendages of any sort, but simply as irregularities in the growth of the hammer itself. During this growth the appendages either disappear or become so small in comparison with their surroundings as to escape notice. *Lumpi* does not seem to have any such processes, but the surface of the hammer ramains smooth and quite hard. This fact, combined with a great difference in the length of the neck and a smaller difference in the shape and size of the genital segment, constitutes at present the chief distinction between the two species. Until we can obtain young females, which show the details of the several appendages, and males to compare with those of *lumpi*, the two species can not be fully differentiated.

Genus REBELULA Poche.

Lophoura Kölliker, Zeit. für wiss. Zool., vol. 4, 1853, p. 299.—Cornalia, Atti del Soc. Italiana di sci. nat., vol. 9, 1866, p. 1.

Rebelula Poche, Zool. Anz., vol. 26, 1902, p. 17.

Hepatophilus Quidor, Archiv. Zool. Paris, ser. 5, vol. 10, 1912, p. xliii.

External generic characters of female.—Cephalothorax cylindrical, elongate, soft, and sometimes transversely wrinkled; neck narrower that the cephalothorax, cylindrical, fully chitinized, and armed at its anterior end with short chitin knobs, large swollen processes, or profusely branched horns. Trunk or genital segment heart-shaped, flattened dorsoventrally and produced posteriorly into a pair of broad lateral lobes, with a much smaller pair inside of them at the bases of the egg strings; abdomen represented by a median unpaired lobe fused with the trunk and projecting more or less. A pair of posterior processes, covered with respiratory cylinders, attached to the dorsolateral surface of the abdomen. Egg strings longer than these processes; eggs small and multiseriate. First antennae reduced to minute knobs; second pair in the form of spherical processes; proboscis projecting very little; first maxillae reduced to tiny knobs, tipped with a single spine; maxillipeds and swimming legs not visible in the matured adult.

Internal generic characters of female.—Esophagus bent into an S curve, entering the stomach at the anterior end; stomach not much enlarged, passing insensibly into the intestine, which is narrowed into a thread in the neck, widened in the genital segment, and abruptly contracted into a short rectum in the abdomen. A system of profusely branched processes connected with the anterior portion of the intestine in the trunk. Cement glands at the extreme postero-lateral margins of the trunk, not segmented; ovaries just in front of the cement glands; oviducts coiled inside of the cement glands, coils not separated by muscles, but the latter are grouped in bundles, usually two anterior and two posterior; no excretory glands visible.

External generic characters of male.—Cephalothorax short, without a carapace but with a large spherical swelling on either side of the dorsal surface, containing the testis. Thorax distinctly segmented, the segments increasing in size posteriorly; no abdomen but a small lobe at the posterior end of the genital segment on either side, tipped with a long, stout spine. First antennae uniramose and segmented; second pair uncinate, with a rudimentary endopod; first maxillae biramose, rami one-jointed; second maxillae made up of a single joint, tipped with a strong claw; maxillipeds with elongate basal joints, completely fused, terminal joints separate and tipped with powerful claws.

Internal generic characters of male.—Esophagus inclined to the head axis, entering the stomach at the anterior end on the ventral surface; stomach not much enlarged, passing insensibly into the intestine, which runs straight through the center of the body to the anus. Testes paired and spherical, situated in the back of the head; sperm ducts leading from their posterior ends along the center of the lateral margins to the large spermatophore receptacles in the genital segment. The cement glands surround the posterior portion of the sperm ducts; a single large maxillipedal gland in the fused bases of the maxillipeds; a small three-lobed gland on either side of the intestine in the third thorax segment; a still smaller one on either side of the intestine near the anus; minute median glands on the ventral surface of the first and fourth segments and the dorsal surface of the second segment, and a long frontal gland above the stomach near the anterior end of the head.

Type of the genus.—Rebelula edwardsii (Kölliker), monotypic.

(*Rebelula*, to Dr. H. Rebel, of Vienna.)

Remarks.—The distinguishing characters of this genus in the female are the soft cylindrical cephalothorax, the narrow chitin neck with its armature of knobs, processes or horns, the posterior processes covered with respiratory cylinders, and the profusely branched intestinal outgrowths in the anterior trunk. In the male the characteristic features are the oblique truncation of the head, the spherical enlargements for the testes, and the elongated fused basal joints of the maxillipeds.

The genus was first described under the name *Lophoura* by Kölliker in 1853; Claus added some details and gave a figure of the adult female in 1860, and in 1865 Cornalia published a detailed account with numerous figures, both of which were so accurate as to leave no doubt of the identity of the species. Poche in 1902 called attention to the fact that the name *Lophura* had been preoccupied for a genus of birds in 1822 and a genus of reptiles in 1840, and suggested the name *Rebelula* as a substitute.

In 1912 Brian in the Resultats des Campagnes Scientifiques du Prince de Monaco, Fascicle 38, again described (p. 28) and figured (pl. 4, figs. 3 and 4; pl. 8, fig. 4, *a–d*) Kölliker's species, which had been obtained from *Macrourus atlanticus* Lowe, in the Bay of Biscay. He found a number of differences in the details of the head and neck, and discovered the maxillae behind the mouth tube, but failed to find any of the other appendages.

In the same year Quidor discovered what he claimed to be a new genus upon a *Macrourus* from the Sudan coast in Africa, and which he named *Hepatophylus*. This proves to be not a new genus, but a new species of the present genus, and is identical with those enumerated below from the same host. Males of this genus are here described for the first time.

ARTIFICIAL KEY TO THE SPECIES.

Cephalothorax short, wide, transversely wrinkled; neck armed with branched horns; genital segment obcordate; posterior processes long and covered with cylinders---------------------------------------*cornuta*, new species, p. 582.

Cephalothorax long, wide, smooth; head separated by a deep constriction; neck armed with four unbranched knobs; genital segment quadrate; posterior processes short, covered with cylinders----*edwardsii* (Kölliker), 1853, p. 586.

Cephalothorax long, narrow, smooth; neck armed with three spherical processes or four short, unbranched horns; genital segment obcordate; posterior processes short, covered with cones----------*bouvieri* (Quidor), 1912, p. 579.

Cephalothorax filose, ten times as long as wide; neck twisted and armed with small, irregular knobs; posterior processes short and covered with cones. *gracilis*, new species, p. 585

REBELUA BOUVIERI (Quidor).

Plate 53, figs. 34–40; plate 54, figs. 41–44.

Hepatophylus bouvieri Quidor, Archiv. Zool., Paris, ser. 5, vol. 10, 1912, p. xliii, figs. 5 and 6, text.

Host and record of specimens.—The collection of the National Museum contains 25 females and 1 male of this species, all obtained by the Bureau of Fisheries steamer *Albatross* from the common rattail, *Macrourus bairdii*, of the deep Atlantic and numbered as follows:

Specimens.	Station.	Locality.	Date.	Cat. No. U.S.N.M.
1 female	895	Off Marthas Vineyard	1880	6127
Do	1029	do	1881	6128
Do	1140	do	1882	6129
Do	894	do	1880	6130
Do	894	do	1880	6131
Do	894	do	1880	6133
Do	1029	do	1881	6134
Do	894	do	1880	6135
Do	895	do	1880	6136
2 females	2212	Off New Jersey	1884	42340
1 female	2202	do	1884	42344
Do	2212	do	1884	45731
Do	1096	Off Marthas Vineyard	1882	49749
2 females	2212	Off New Jersey	1884	49750
3 females	2202	do	1884	49751
1 female	2179	do	1884	49752
2 females	2186	do	1884	49753
1 female				49765
Do	2189	Off New Jersey	1884	49766
1 male, 1 female	1153	Off Marthas Vineyard	1882	49748

The anterior portion of the parasite was buried in the flesh of the host beside or behind the dorsal fin, with only the genital segment and egg strings visible. A large cyst was formed around the head and neck, and in the case of No. 49748, whose host was only 7 inches in length, the cyst was so large that it bulged out on both sides of the body. Quidor reported two specimens from the same host, and this was true of No. 49750, but in all the other instances there was but a single parasite on a host.

Specific characters of female.—The cephalothorax of this species is cylindrical, four times as long as wide, and tapers gradually toward the tip. The surface is perfectly smooth and devoid of wrinkles. Near the tip is a groove where all the longitudinal muscles are interrupted, and which separates a terminal portion, of about the same length and width, representing the head. The extreme anterior portion of this head is again separated by a groove which extends from the posterior base of the second antennae to the maxillipeds on the ventral surface. The end of the head, distal to this groove, shows five rounded processes, two dorsal, two ventral, and one median, all more or less fused together.

Behind the cephalothorax is a slender neck, one-third the diameter of the cephalothorax and of varying length. This is fully chitinized and its surface is in some specimens perfectly smooth, in others raised into knobs irregularly disposed. It is attached to the center of the anterior end of the genital segment. At the point of junction of the cephalothorax and neck in all the specimens above enumerated are three large spherical processes, two lateral and one dorsal. The diameter through these processes is three times that of the cephalothorax and nine times that of the neck. Quidor found at this point "four cornes, deux dorsales et deux ventrales, dirigees obliquement vers l'arriere, de haut en bas et longues de 3 mm." (p. xliii). But as this is the only difference between his specimens and the present ones, it does not seem sufficient to constitute a separate species. The processes are smooth, with a thick chitinous skin and evidently serve the same purpose as the short horns that Quidor found, namely, the anchoring of the parasite to its host.

The dorsal and ventral surfaces of the genital segment show pits or depressions on either side between the midline and the lateral margin. These pits are of various sizes, numbers, and arrangement, but are most usually four in number, two anterior and two posterior, shaped like parenthesis marks. They are undoubtedly the "deep depressions, funnel-shaped and semilunar" noted by Cornalia at the posterior end of the genital segment, and which he found to be connected on the inside with a strong muscle band. He did not notice or did not mention the anterior ones. But his explanation of them as sucking disks for prehensile purposes is plainly erroneous. The muscles are like those in *Sphyrion*, only here they are gathered in bundles instead of being scattered promiscuously, and the pits on the dorsal and ventral surfaces correspond to the ends of the muscle bundles. When placed in preservatives the muscles usually contract, producing the pits, but they sometimes remain relaxed and then the surface of the genital segment is smooth, although the attachment of the muscles can still be seen through the skin.

The genital processes at the posterior end of the segment are on a level with the ventral surface, and each is double, consisting of a dorsal and ventral portion, between which is the opening of the oviduct. The two portions are not in line and so appear double whatever the point of view. From the ventral portion projects a small knob, at whose tip is the opening of the duct leading to the sperm receptacle.

The egg strings are comparatively very large, as long as the entire body and one-third as wide as the genital segment; they taper toward the tip, which is bluntly rounded. The eggs are minute; they are not arranged in regular rows, but there are between 75 and 100 in a cross ction of each string, while lengthwise there are from 225 to 250.

This gives a total of 15,000 to 20,000 for each string. Such an exceptional number is explained when we recall that the host of this parasite is a deep-sea fish, living at a considerable depth, which adds greatly to the difficulty experienced by the larva of the copepod in finding a host.

The abdomen is on a level with the dorsal surface of the genital segment; it has the form of a spherical knob, split lengthwise at the tip by the anus. It is completely fused with the genital segment, and from the fused dorsal surface arise the posterior processes. These are covered, not with true cylinders, as in *R. cornuta* and *R. edwardsii*, but with elongated cones which taper from the point of attachment to the distal end. This end is sometimes enlarged and more or less spherical and sometimes divided into two short branches. Each process carries about 40 or 50 of these cones.

The first antennae are reduced to tiny knobs on the dorsal surface of the head; the second antennae are probably replaced by the spherical processes at the anterior margin of the head, although in the adult they have lost all traces of appendages. The mouth tube is on the front of the head and ventral to these processes; it does not project from the surface, but is supported by a chitin framework provided with muscles which probably make it more or less protrusible. On either side of the mouth is a small rounded papilla, tipped with a spine, which represents the first maxilla. Ventral to the mouth is a similar pair of small knobs, each tipped with two spines, which are the second maxillae. Farther back on the ventral surface at the base of the fused ventral processes and in front of the groove differentiating the head is a pair of rudiments which probably represent the maxillipeds. They correspond in position with those of *Sphyrion*, but for certainty younger stages of the female must be examined.

On examining the internal morphology of the trunk we find the anterior portion of the enlarged intestine covered with processes. These are apparently arranged in longitudinal rows like those in *Shyrion*, but the anterior ones are many times the length of the posterior ones and are profusely branched, so that they fill the entire cavity of the trunk for the anterior fourth of its length, and their tips are flattened against the inside of the walls of the trunk. They then diminish rapidly and regularly in length and in complexity of branching and cease at about the center of the trunk. They thus form a conical mass filling the entire anterior diameter of the trunk and then tapering down to the diameter of the intestine. No dorsoventral muscles can be seen in this portion of the trunk, but there is a bundle of them just behind these processes near the lateral margin and another farther back and nearer the intestine. The cement glands are at the posterolateral margins of the genital segment; they are narrow, curved in the form of parenthesis marks, and are not segmented. The ovaries are inside the cement glands, and the oviducts are coiled back and forth in the space between the cement glands and the intestine.

Color (preserved material), a uniform yellow-gray, deepened into brown in the neck and genital segment and into orange in the egg strings. Total length, exclusive of the posterior processes, 30–40 mm. Cephalothorax, 10–15 mm. long, 2.50–3 mm. wide. Neck, 10–15 mm. long, 0.50 mm. wide. Trunk, 10–15 mm. long, 6–10 mm. thick, 8–12 mm. wide. Posterior processes, 7–9 mm. long. Egg strings, 30–40 mm. long, 3–4.50 mm. wide.

Specific characters of male.—In the male of this species the front of the head is not as obliquely truncated as in *cornuta*, the swellings on the dorsal surface which contain the testes do not project as prominently, and the posterior part of the head is relatively much thinner; the fused basal joints of the maxillipeds are not as thick or as long, the thorax is relatively shorter and narrower, and the stout conical spines at the posterior end of the genital segment are replaced by a pair of tiny knobs. Internally each testis reaches around the side of the intestine almost to the ventral surface and the cement portion of the sperm duct is relatively larger, especially in the third and fourth segments.

The first antennae are three-jointed, but the terminal and basal joints are short, and the basal joint is not flattened laterally. In the second antennae the three basal joints are about the same length, but diminish regularly in width; the cylindrical process of the second joint is given off at the base of the joint instead of the distal end, and all the joints are relatively shorter than in *cornuta*.

The first and second maxillae are the same as those of *cornuta*, but the terminal claw of the maxillipeds is not as stout, and the second joint is armed with three short spines.

Color (preserved material), a uniform yellow-white. Total length, 3 mm. Diameter of back of head, through the testes, 0.51 mm. Dorsoventral thickness of same, 0.51 mm. Diameter of genital segment, 0.50 mm.; thickness, 0.25 mm.

(*bouvieri*, to Prof. E. L. Bouvier.)

REBELULA CORNUTA, new species.

Plate 55.

Host and record of specimens.—A single female with attached male was obtained off Ochiishi Saki, at the eastern end of Hokkaido, Japan, from the flesh on the side of a *Synaphobranchus affinis* Gunther, dredged from a depth of 359 fathoms by the Bureau of Fisheries steamer *Albatross*, October 3, 1906. The female has been given

Cat. No. 49758 U. S. N. M., and becomes the type of the new species; the male was cleared in clove oil and mounted.

Specific characters of female.—Cephalothorax soft, cylindrical, the same diameter throughout, and transversely wrinkled; it is squarely truncated anteriorly and surrounded by a raised margin, broken on the ventral surface but continuous elsewhere. Neck narrower than the cephalothorax and fully chitinized, bearing on its anterior end four profusely branched chitin horns, arranged approximately at the four angles of a square. Each horn has a thick base which is immediately divided into two branches, the division taking place so close to the surface of the neck that it might be said there were eight horns arranged in pairs. The branches are irregular, long, and slender and twisted until they are more or less parallel with the neck; they are bluntly rounded at the tips. Behind the horns the neck is smooth, hard, and thick-skinned, and within a short distance is bent at right angles ventrally; it is then straight and of uniform diameter until just before it reaches the genital segment, where it is slightly narrowed and joins the latter at its anterior end and at right angles to the ventral surface. These two flexures being in the same plane leave the head and anterior neck parallel with the trunk axis and directed backwards.

The trunk is elongate obcordate, flattened dorsoventrally, the narrow end joined to the neck, the wide posterior end rounded into a broad lobe on either side and slightly reentrant at the center. On the dorsal and ventral surfaces are wide, deep grooves on either side half way between the midline and the lateral margin. Along the bottom of each groove is a row of five or six shallow pits. Inside of the lateral lobes at the posterior end are the genital processes, which are spherical and close to the median line, and from whose inner, distal corners are given off the egg strings. The abdomen has the form of a spherical knob split at the end by the anus, and projects from the center of the posterior end of the trunk dorsal to the genital processes. To its dorsolateral margins are attached the posterior processes, which are stout and as long as the trunk, each bearing about 75 respiratory cylinders, which increase in length distally. Each cylinder is contracted where it joins the process into a short filose neck, usually bent at right angles, so that the cylinder trails back in the water nearly parallel with the process. The rest of the cylinder is of the same diameter, is 10 to 15 times as long as wide, and the free end is bluntly rounded and without enlargement or division. The egg strings were lacking in the single specimen obtained.

In the center of the anterior end of the cephalothorax are the second antennae, which are swollen, finger-like processes, somewhat resembling those of *Sphyrion*, but relatively smaller. On their tips are two minute papillae, all that is left of the chela. Dorsal to the bases of these antennae is a pair of small knobs which represent the first antennae; ventral to them is the mouth opening, which does not show any maxillae.

Color (preserved material), yellowish gray tinged with brown on the neck and genital segment.

Total length, excluding the posterior processes, 32 mm. Cephalothorax, 3 mm. long, 1.66 mm. wide. Neck, 1.66 mm. in diameter. Trunk, 15 mm. long, 10 mm. wide at the posterior end. Posterior processes, 20 mm. long, 15 mm. wide.

Specific characters of male.—The anterior end of the head is cut at an angle of 45° with the body axis, and on the flattened disk thus produced are the two pairs of antennae, the mouth tube, and the first maxillae.

The antennae are attached about two-fifths of the distance from the lateral margin to the center of the disk, the anterior pair slightly nearer together than the posterior, both pairs projecting at right angles to the surface of the disk. Each anterior antenna is three-jointed, the basal joint as long as the other two, three times as wide, and flattened laterally, carrying on its inner surface a long slender seta. Each posterior antenna is four-jointed, the second and fourth joints about the same length, the basal one shorter and wider; the second joint carries on its posterior margin near the distal end a narrow cylindrical process, tipped with a single long seta; the terminal joint is armed with a small claw. The mouth tube projects as a regular proboscis, similar in all respects to those of the Lernaeopodidae. At its base on either side is a maxilla made up of a stout basal joint and two 1-jointed rami of the same size, each of which is tipped with two setae. The sides of the second maxillae project inward in the form of a broad flap or lamina at the base of the terminal claw. The terminal joints and claws of the maxillipeds project at the tip of the long fused basal joints like the jaws of a chela on a long handle. The ends of the basal joints between the claws are armed with short and stout spines.

Color (preserved material), a uniform yellow-white.

Total length, 2.25 mm. Greatest diameter, 0.66 mm.

(*cornutus*, horned, alluding to the attachment horns on the neck of the female.)

Remarks.—The distinguishing characters of this species are the profuse armature of branched horns on the neck of the female and the peculiar diagonal truncation of the head in the male. To these may be added the double flexure of the neck and the transverse wrinkling of the cephalothorax, the elongation and shape of the trunk, the length of the posterior processes, and the large number of cylinders, all belonging to the female. In the male the testes at the back of the head protrude much more than in *bouvieri*, the maxillipeds are considerably longer, while the spines at the posterior end of the body are shorter and smaller. When taken in connection with the differences in the details of the appendages these characters serve to establish the species. The single specimen obtained does not necessarily mean that the species is scarce, because its host is a deep-sea fish, and not many specimens have been examined for parasites.

REBELULA GRACILIS, new species.

Plate 53, fig. 33; plate 54, fig. 45.

Host and record of specimens.—Two females, one with egg strings and the other without, were obtained by the Bureau of Fisheries steamer *Albatross* off Marthas Vineyard in 1882 from *Synaphobranchus pinnatus*. The first of these is made the type of the new species with Cat. No. 49754, U.S.N.M.; the other becomes a paratype, with Cat. No. 49755, U.S.N.M. Another species without egg strings was obtained off New Jersey by the Bureau of Fisheries steamer *Albatross* in 1884 from *Histiobranchus infernalis*, and has been given Cat. No. 49756, U.S.N.M. A fourth specimen, also without egg strings, was obtained at the same time and place from *Synaphobranchus pinnatus*, and was numbered 6126, U.S.N.M.

Specific characters of female.—Cephalothorax narrow and from 10 to 15 times as long as wide, transversely wrinkled posteriorly but smooth anteriorly, the smooth part considerably wider than the wrinkled portion, which passes insensibly into the chitinous neck. Head separated from the rest of the cephalothorax by a deep groove, as in *edwardsii;* neck very slender anteriorly, bent and twisted in different directions, considerably thickened, and straight posteriorly. It is armed on the slender portion, about one-third of its length from the anterior end, with several irregular chitin knobs, whose combined diameter is not more than three times that of the neck itself. The neck joins the anterior end of the genital segment, usually at an obtuse angle with the dorsal surface of the latter. Trunk comparatively large and thick, obcordate, but much wider anteriorly than in *cornuta*, namely, three-fourths as wide and half as thick as long. The pits on the dorsal and ventral surfaces are but little sunken in any of the specimens and their edges usually protrude a little.

The lateral posterior lobes are practically lost in the general contour of the trunk; the genital processes are small and spherical. The posterior processes are a little more than half the length of the trunk and are covered with elongated cones, which are enlarged but not divided at their tips, and are all about the same length. The egg strings are as long as the entire body, but much narrower than in *bouvieri;* the width less than one-twentieth of the length.

The head is a narrow lobe at the anterior end of the cephalothorax, less than half the width of the latter, and somewhat three-cornered in both dorsal and ventral views, widest along the anterior margin and narrowing to a rounded point posteriorly. From the center of the anterior margin project the second antennae, which are rather small transverse ellipsoids. Between these and the dorsal surface of the head, and entirely concealed by them, are the small knobs representing the first antennae.

On the ventral surface of the head, a short distance behind the bases of the antennae, is the mouth opening. On either side of this and some distance from it are the first maxillae, and behind the opening are the second maxillae, close together on the midline. On either side of the head is a large pad-like process, curved both dorsally and ventrally, and ending in bluntly rounded points, those of the two processes not quite meeting on the dorsal and ventral surfaces.

Color (preserved material), a yellow-white; the neck and trunk with a brownish tint, the egg strings a deep orange.

Total length, including the posterior processes, 55 mm. Cephalothorax, 15 mm. long, 1–1.50 mm. in width. Neck, 15 mm. long, 0.50 mm. wide anteriorly, 1 mm. wide posteriorly. Trunk, 15 mm. long, 12 mm. wide, 8 mm. thick. Posterior processes 10 mm. long. Egg strings 42 mm. long, 2 mm. wide.

(*gracilis* slender.)

Remarks.—The distinguishing characters of this species are the narrow and elongated cephalothorax, neck, and egg strings, the tiny three-cornered head, the twisting of the neck and its armature of small, irregular knobs, and the large and plump trunk. The two hosts upon which it was found are closely related fishes of the deeper portions of the Atlantic.

REBELULA EDWARDSII (Kölliker).

Lophoura edwardsii Kölliker, Zeit. für wiss. Zool., vol. 4, 1853, p. 299.
Lophoura edwardsii Cornalia, Atti del soc. Italiana di Sci. Nat., vol. 9, 1865, p. 1.

Host and record of specimens.—Kölliker's specimens were secured at Messina from the body of a *Lepidoleprus caelorhynchus*, while Cornalia's were taken from the same host at Naples. The latter were fastened in the flesh above the vertebral column, the head passing in between the spinous apophyses of the vertebrae to the dorsal aorta.

Specific characters of female.—The following account is adapted from Cornalia, who has given us the best description of the species. The anterior part of the body is made up of a soft cylinder, about 1 mm. in diameter, with a roughened skin. The extreme tip of the cylinder may be regarded as the true head, and it is separated from the part behind it by a narrow constriction forming a sort of neck. This head carries five nonarticulate, fleshy projections, arranged in pairs with a single, unpaired one in the center. The anterior pair are a little smaller and closer together, while the posterior pair are larger and farther apart; the mouth is just behind the central, unpaired projection. The rest of the cylinder is of the same diameter as the head and without appendages.

Behind this cylinder is the neck, 0.20 mm. in diameter, and joining both the cylinder and the trunk abruptly. Just behind the cylinder the neck is armed with four short, bluntly rounded processes, extending out at right angles to the neck axis like four diagonals of a square.

The trunk is rectangular, a little longer than wide, with rounded corners, and flattened dorsoventrally. The skin covering it is smooth, chitinous, and rather thick, showing plainly the attachment of the four bundles of dorsoventral muscles, two anterior and two posterior. From the center of the posterior margin of the trunk projects the spherical abdomen, and on either side of this is a smaller genital process, out of which opens the oviduct. To the abdomen are attached the posterior processes, each composed of a central filiform shaft, carrying, at short intervals, the respiratory cylinders, of which the anterior two or three are shorter than the rest. There are 16 to 18 of these cylinders on each process, and they are all of the same diameter, which is a little greater than that of the neck, and have bluntly rounded ends, which are neither swollen nor divided.

Color whitish, tending to yellow; darker on the neck and trunk. Total length, including the posterior processes, 29 mm. Cephalothorax, 4 mm. long, 1 mm. wide. Neck, 6 mm. long, 0.20 mm. wide. Trunk, 9 mm. long, 8 mm. wide. Posterior appendages, 10 m. long.

(*edwardsii*, to H. Milne Edwards.)

Remarks.—While Cornalia's description is in the main correct, there are one or two points that require notice. Neither Cornalia nor Claus, who had added[1] some important observations with reference to "*Lophoura*," knew how to interpret the four processes on the neck. Claus even went so far as to say that they were nothing but the chitinized ends of the ventral muscle strands, which stood out at this point as small ridges in consequence of an injury. Cornalia criticized this interpretation, but offered nothing in its place.

In Cornalia's specimens the muscle fibers in the center of the dorsoventral bundles in the trunk are strongly contracted, while those around the margin of the bundles remain relaxed. This drew in the body wall at the center of the bundle and formed a "deep depression, funnel shaped and semilunar, the lumen of which is occupied by a chitinous lamina."

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[1] **Wurzburger naturwiss. Zeitsch., vol. 1, 1860, p. 20.**

This was interpreted as a sort of sucker for prehension, but of course performs no such function as that.

In endeavoring to locate the genus Cornalia called attention to the resemblance between *Sphyrion* and "*Lophoura*" in the general make-up of the body, and between "*Lophoura*" and *Haemobaphes* in their mode of attachment to their host and in the body divisions.

Genus TRYPAPHYLUM Richiardi.

Lerneonema, part, P. J. van Beneden, Ann. Sci. Nat., ser. 3, vol. 16, 1851, p. 125, pl. 6, figs. 11 and 12; Bull. Acad. Belgique, vol. 18, 1851, p. 287, pl. 1; L'Institut, vol. 19, 1851, p. 285.

Lernconema Vogt, Recherches Cotières, 1877, p. 69, pl. 8, fig. 11, male.

Trypaphylum Richiardi, Atti del Soc. Toscana, vol. 1, 1878, p. xx.

Lernaeenicus Bassett-Smith, Proc. Zool. Soc. London, 1899, p. 485.

Tripaphylus Carus, Prod. Faunae Mediterraneae, 1885, p. 372.

Tripaphylus T. and A. Scott, British Parasitic Copepods, 1913, pp. 160 and 229, pl. 45, fig. 6; pl. 51, fig. 1; pl. 49, figs. 1–7.

Generic characters of female.—Body slender and greatly elongated, without segmentation. Cephalothorax rounded and provided with stiff cartilaginous horns. Free thorax forming a long and slender neck, filiform antieriorly, considerably widened posteriorly. Trunk narrowed anteriorly to the width of the neck, widened posteriorly and furnished with two long and slender posterior processes, which are straight, cylindrical, and smooth like those in *Paeon* and *Opimia.* Antennae and mouth parts similar to those of *Lernaeenicus.*

Generic characters of male.—Cephalothorax slender, conical, without a carapace and with no external indication of the testes. Thorax indistinctly segmented anteriorly, completely fused posteriorly; genital segment swollen and tipped with a pair of slender conical processes; no abdomen. First antennae uniramose, indistinctly jointed; second pair biramose, the exopod chelate. Mandibles with strong curved teeth at the tip like those in the Lernaeopodidae. Basal joints of second maxillae and maxillipeds fused, terminal joints free and armed with strong chelae.

Type of the genus.—*Trypaphylum musteli*, monotypic.

(*Trypaphylum*, τρυπάω, to bore and φῦλον, race or tribe.)

Remarks.—In 1851 P. J. van Beneden established a new species which he named *musteli* and referred to Milne Edwards's genus *Lerneonema.* He obtained it from the gills and pharyngeal cavity of *Mustelus vulgaris* on the Belgian coast. Later in the same year he published a more complete account of the species. Vogt in 1877, reviewing Beneden's description and figures, said that the male showed that the genus belonged to the Lernaeopodidae. Bassett-Smith in 1899 assigned the species to the genus *Lernaeenicus* without giving any reason for such action. Richiardi in 1878 claimed it as a new genus which he named *Trypaphylum*, but he added nothing to Beneden's description. It was enumerated under this new name, with a change in the spelling, by several subsequent authors, including T. and A. Scott. In their excellent monograph on British Parasitic Copepods Richiardi's genus was included and a brief diagnosis of both sexes was given. From this account the present author has borrowed very freely and acknowledges his deep indebtedness. Unfortunately, no description has ever been given of the antennae and mouth parts of the female, and in all the figures that have been published the head of the female has been lacking. We are thus prevented from locating the female exactly, but if the male, which was admirably described and figured by the two Scotts, is of the same species it shows beyond a doubt that the genus does not belong to the Lernaeidae. No Lernaean male lives long enough to appear with the female on the final host, nor does it bear any resemblance to this *Trypaphylum* male. And the differences between this male and those belonging to the Lernaeopodidae are just as great.

On the other hand, there is a close similarity between the male described by the Scotts and the two here given for the genus *Rebelula*. Indeed, the only difference is the lack in the former of the prominences at the back of the cephalothorax, containing the testes; but this is more than offset by the elongation and complete fusion of the basal joints of the second maxillae and maxillipeds. It is also worthy of note that at the time the species was originally established Beneden called attention to its close affinity with the genus *Sphyrion*, and several other authors have commented on this same relation. Accordingly, in so far as we are acquainted with the details of the structure of the two sexes, the genus *Trypaphylum* belongs with the other genera in the Sphyriidae. Only one species has ever been described, so that the genus is monotypic, but the specific name must be credited to Beneden and not to Richiardi.

Genus OPIMIA Wilson.

Opimia WILSON, Proc. U. S. Nat. Museum, vol. 35, 1908, p. 459.

Generic characters of female.—General form elongate and slender, without any traces of segmentation; cephalothorax swollen into a globe or sphere, smooth and without processes or horns. Neck cylindrical, of the same diameter throughout and two-thirds of the entire length. Trunk narrow, longer than wide, with a single pair of posterior processes, which are smooth, straight, and cylindrical; abdomen short and rudimentary.

First antennae one-jointed papillae; second pair stout, uniramose, and uncinate; mouth tube terminal, protruding; one pair of maxillae;

maxillipeds well developed and tipped with strong claws; one pair of swimming legs close behind the maxillipeds. Male unknown.

Type of the genus.—*Opimia exilis* Wilson, monotypic.

(*Opimia*, a vestal virgin unfaithful to her vow.)

Remarks.—When first established this genus was placed with the Lernaeidae, since its near relatives belonged there. But at the revision of the Lernaeidae[1] it was decided that *Opimia* and its relatives could no longer remain in the family, and accordingly the present new family has been formed to include them. *Opimia* is very close to *Trypaphylum* and the new genus *Paeon*, and the three differ from *Sphyrion* and *Rebelula* chiefly in the fact that the posterior processes are unbranched and are not covered with respiratory cylinders or cones. The distinguishing characters of the genus are the smooth cephalothorax without processes or horns, the stout maxillipeds, and the single pair of swimming legs.

PAEON, new genus.

External generic characters of female.—Body separable into three regions—cephalothorax, neck, and trunk; cephalothorax enlarged into a transverse ellipsoid whose surface is produced into paired processes. Neck slender and nearly straight, but showing considerable torsion. Trunk swollen, flattened dorsoventrally, and furnished posteriorly with a pair of long and slender processes dorsal to the egg strings; abdomen minute with a pair of globular anal laminae, and completely fused with the genital segment. Egg strings straight; eggs multiseriate. No antennae visible; proboscis retractile; a pair of biramose maxillae on the sides of the mouth tube; a second pair of maxillae behind the mouth, one-jointed and armed with stout claws; no swimming legs.

Internal generic characters of female.—Esophagus inclined and entering the stomach on its ventral surface near the anterior end; stomach not much enlarged, without lobes or processes, passing insensibly into the intestine, which is filose in the neck, is enlarged, but without processes, in the trunk, where it is nearer the dorsal surface, and is contracted into a short rectum, which opens between the anal laminae. Ovaries paired, at the sides of the genital segment in front of the cement glands; oviducts coiled transversely, the coils kept in place by strands of dorsoventral muscles. Cement glands at the posterolateral corners, close to the body wall, unsegmented, with short ducts. Body wall thin and not chitinized.

External generic characters of male.—Cephalothorax elongate and covered with a carapace; second thorax segment well separated; third, fourth, and fifth segments fused more or less completely, and armed posteriorly with a pair of long conical processes tipped with spines; no abdomen.

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[1] Proc. U. S. Nat. Mus., vol. 53, pp. 1–150.

First antennae indistinctly jointed; second pair bipartite at the tip; first maxillae on the sides of the mouth tube; second pair stout and uncinate; maxillipeds also stout, their basal joints fused, the terminal joints chelate.

Internal generic characters of male.—Espohagus in line with the head axis and opening into the anterior end of the stomach on its ventral surface. Stomach passing insensibly into the intestine, which is abruptly contracted into a short rectum at the posterior end of the genital segment. Testes in the back of the head opposite the maxillipeds; sperm ducts running straight back on either side of the intestine and enlarged into rather small spermatophore receptacles at the posterior end of the genital segment; no glands visible.

Type of the genus.—*Paeon ferox*, new species.

(*Paeon*, a son of Posseidon.)

Remarks.—This is a genus of shark parasites found in the mouth and gill cavity, the head and long neck buried in the tissues of the host, with nothing but the soft trunk, the posterior processes, and the egg strings visible.

The head of the parasite is usually near the ventral aorta of the host, and the irritation caused by the burrowing forms a well-defined cyst around the copepod's head and neck, which stiffens the tissue and adds considerably to the effectiveness of the attachment.

The head and neck are tough and leathery and yet soft enough to yield readily to pressure, so that when endeavoring to remove the creature from the cyst the head will often squeeze out of a small cut, apparently all out of shape. But the elasticity of the tissue restores the normal shape perfectly as soon as the pressure is removed. The trunk and posterior appendages are soft and much less elastic, and it is hence very difficult to preserve the animal in its normal form. They must be kept straight and extended in the preservative in the same way that cestodes and similar material are handled. In water they are capable of considerable motion, writhing about like a worm and coiling and uncoiling their long necks and bodies. By this means they can move about over the bottom of the vessel containing the water and can even raise themselves off the bottom to some extent. But they only live from 36 to 48 hours under such conditions, and it is not at all probable that they ever have occasion to use this form of motion under natural conditions.

KEY TO THE SPECIES.

Head obcordate; neck much wrinkled; trunk also obcordate, as wide as long, *versicolor*, new species, p. 596.

Head transversely elliptical; neck rather smooth; trunk much longer than wide, squarely truncated posteriorly.............*ferox*, new species, p. 592.

PAEON FEROX, new species.

Plate 56; plate 57, figs. 60, 61, 63, 64, 66.

Host and record of specimens.—Twelve females, two of them with attached males, were obtained by the author from the gill cavity of the sharp-nosed shark, *Scoliodon terrae novae*, in July, 1905, at Beaufort, North Carolina. These have been divided into three lots—the first, a single female with egg strings, is made the type of the new species with Cat. No. 47824, U.S.N.M. Four other females become paratypes with Cat. No. 47825, U.S.N.M., and the remaining seven are also made paratypes with Cat. No. 47826, U.S.N.M.

External specific characters of female.—Cephalothorax enlarged transversely by a pair of hemispherical lateral processes into a tolerably regular ellipsoid, upon the anterior and ventral surfaces of which are several pairs of knobs or protuberances. One pair are dorsoventrally elliptical and extend across the anterior margin so as to be visible in a dorsal as well as a ventral view. Their adjacent surfaces meet on the midline and are flattened together; their dorsal surfaces are about on a level with the dorsal surface of the head, but ventrally they project considerably and conceal the mouth tube. A little behind them on the ventral surface is a second pair, diagonally elliptical, with their long diameters at right angles to each other and at an angle of 45° with the axis of the head. Their outer ends are opposite the outer margins of the first pair and reach laterally a little beyond them. Their posterior margins are concave and at about the center of each, on the dorsal surface between the knob and the head itself, lies a slender finger-like protuberance, jointed near its base and divided at the tip, and looking much like a misplaced appendage. It contains what appear to be muscles and might easily have migrated to its present position during the outgrowth of the knobs.

On the anterior margin of the head between the bases of the first pair of knobs are the proboscis and mouth parts. The mouth tube is conical and protrusible, with well-defined upper and under lips like those in the male, and carries on either side a biramose maxilla. Each maxilla is made up of a short basal joint, widened dorsoventrally, and two rami. The endopod (dorsal ramus) is one-jointed and club-shaped, bluntly rounded at the larger distal end with a spine on its outer surface; the exopod is two-jointed, the terminal joint ending in a long ventral and a short dorsal spine. Just behind the mouth tube on the ventral surface of the head and in front of the oblique processes are the second maxillae. Each is stout, one-jointed, and ends in a strong claw, bent into a half circle and armed at its base on the ventral surface with a slender acuminate spine. The two are inclined toward each other so that their claws meet on the median line, and they are evidently the chief organs of prehension. The posterior ends of the oblique knobs are connected by a ridge across the median line, which curves forward at the center.

A third pair of knobs are spherical and are situated on the ventral surfaces of the lateral processes, so far from the midline as to lie wholly exterior to the base of the neck. The ventral surface of the neck between and behind them projects strongly and on it may be seen the transverse chitin rod that probably connected the bases of a pair of swimming legs.

The neck is one-fourth the width of the head and about one-third the entire length of the body. It is of the same diameter throughout, with fairly distinct segmentation, but with no apparent traces of appendages. Where the neck joins the genital segment, which is the portion in contact with the skin of the host, it is slightly enlarged and thrown up into numerous transverse wrinkles; elsewhere it is tolerably smooth.

Within this wrinkled area the neck passes insensibly into the trunk, which then widens gradually to its posterior end, where it is about the same width as the head. The trunk is more than four times as long as wide, and at the posterior end is three times as wide as thick. Near its anterior end the division between the fourth and fifth thoracic segments is clearly indicated by a break in the longitudinal musculature and by grooves on the lateral margins. The anterior ends of the oviducts extend a short distance in front of this dividing line. The corresponding division between the fifth and genital segments is found near the anterior end of the cement glands, and still farther back is another break just in front of the anal laminae indicating the division between the genital segment and the abdomen.

The surface of the trunk is generally smooth, with a few scattered wrinkles and with small pits caused by the attachment of the dorsoventral muscles that separate the coils of the oviducts. At the posterior end the lateral margin is produced into a rounded lobe on either side, which turns slightly downward and outward. The abdomen is so reduced that it would not be mentioned if it were not for the distinct break in the musculature. But this indicates definitely that the posterior processes are given off from the dorsal surface of the abdomen as in the other genera. Each process is one-third as long as the rest of the body, is curved like a parenthesis mark, has the same diameter throughout, and is bluntly rounded at the end. The anal laminae are swollen into knobs beneath the bases of the posterior processes and more or less fused with them. The egg strings are cylindrical and are attached to the inner margins of the posterior lobes of the genital segment; each is two-thirds as wide and a little longer than the processes; the eggs are arranged in 9 or 10 rows which are twisted inside the tubes.

Internal specific characters of female.—Ovaries paired, one on either side, in front of and dorsal to the cement gland. Each sends out a long oviduct, irregularly coiled to the right and left and filling the space between the intestine and the lateral wall of the trunk, with the white eggs appearing at scattered intervals. The coils are separated and held in place by dorsoventral strands of muscle arranged in irregular transverse rows. In general they turn forward along the dorsal surface of the trunk and backward along the ventral surface to the vulvae, but all the convolutions are very irregular. The eggs assume nearly their full size on issuing from the ovary and then gradually mature while passing through the long oviduct.

At the posterior end of the genital segment and nearer the ventral surface on either side is a cement gland, which is long and cylindrical, the anterior end curved in toward the midline, the posterior end passing into a very short duct which empties into the oviduct near the vulva; neither gland nor duct shows any real segmentation.

A fairly thick layer of chitinogen tissue similar to that found in the Lernaeidae covers the whole lateral surfaces of the genital segment around the ovaries and fills the posterior lobes. Its inner surface is raised in small rounded elevations of irregular shapes and sizes, and in the posterior lobes it is divided similarly into irregular masses.

Color.—Head white and opaque, the knobs tipped with dark-brown pigment; neck transparent and colorless, the digestive tube and muscle bands showing opaque and white. The wrinkled section at the base of the neck is a bright crimson; the genital segment is transparent and jellylike, with a decided orange-yellow tint, the ovaries are darker and more opaque, the eggs are snow white. The posterior processes are jellylike, with a decided yellow tint; the egg strings are yellowish white, turning to a beautiful maroon on ripening. In preservatives the different regions lose their transparency and become a uniform gray-white, while the crimson patch on the neck sometimes becomes dusky, but often regains its bright crimson color after clearing in clove oil.

Total length, including posterior processes, 55 mm. Head, 3 mm. long, 4.50 mm. wide. Neck, 16.50 mm. long, 1.25 mm. wide. Trunk, 17mm. long, 4 mm. wide. Posterior processes, 18 mm. long, 1.50 mm. wide. One specimen was 70 mm. long, with the other measurements in proportion.

Specific characters of the male.—Body plainly segmented with the regions well separated from one another. Cephalothorax considerably more than half the entire length, the anterior portion of it covered by a carapace, which reaches back to the bases of the maxillipeds and does not extend down very far along the sides, thus leaving the mouth parts practically free. The cephalothorax is followed by a small free segment, but the remaining thorax segments are fused together with only indistinct joints.

There is no abdomen, but each of the posterior corners of the genital segment is prolonged into a conical process terminating in a short spine. These processes are close together on either side of the midline, while outside of and anterior to them is a pair of shorter processes with bluntly rounded tips, and anterior to these a pair of small knobs.

The first antennae are indistinctly three-jointed, slender, and conical, tipped with four spines, and with a few setae along the sides. The second antennae are broad and flattened, made up of a stout basal portion which is two-jointed and two terminal rami. Of the latter the endoped is one-jointed with a broad and spatulate tip armed with a single spine; the exopod is indistinctly three-jointed, the last joint carrying a pair of curved claws opposed to each other like the jaws of a chela. Inside of these second antennae on the base of the mouth tube is a pair of maxillae, each made up of a basal joint and two rami. The endopod (dorsal) is one-jointed, bluntly rounded at the tip and unarmed; the exopod is two-jointed, the terminal joint slender, flattened and tipped with two short spines. The mouth tube is relatively large and broadly conical, and extends a little way beyond the tips of the antennae; the mouth opening is surrounded by a fringe of hairs. The second maxillae and maxillipeds are very large; each is made up of three joints, the basal ones stout and armed with powerful muscles, the terminal one a strong curved claw. The basal joints of the maxillipeds are completely fused across the midline.

The testes are situated in the back of the head over the bases of the maxillipeds. The vas deferens leads along the side of the thorax to the spermatophore receptacle at the extreme posterior end of the genital segment. These receptacles are rather small and each contains but a single spermatophore with a short and nearly straight tube.

Color, a uniform snow-white.

Total length, 2 mm. Diameter of cephalothorax, 0.50 mm.

(*ferox*, fierce, bloodthirsty.)

Remarks.—This genus was obtained from the gill cavity of its host and in every instance was attached to the integument which forms the outer wall between the arches. The head and entire neck was buried in the tissues beneath this integument, the neck extending toward the nearest gill arch so as to bring the head and mouth in close proximity to one of the large arteries which supply the gills. The flattened trunk, together with the posterior processes and egg strings, hangs free in the gill cavity. It is nearly always plentifully covered with algae and various protozoa, which trail backward over the egg strings and posterior processes, binding the whole securely together. Both the neck and the head are inclosed in a very tough white membranous sheath which fits snugly and aids in holding the creature securely in place.

PAEON VERSICOLOR, new species.

Plate 57, figs. 62, 65, 67; plate 58; plate 59, figs. 75, 76.

Host and record of specimens.—Eight females, one with an attached male, were found on the inside of the mouth of the smooth hound, *Mustelus canis*, at Beaufort, North Carolina, in August, 1905. One female has been made the type of the new species with Cat. No. 49762, U.S.N.M. The other seven become paratypes, with Cat. No. 49763, U.S.N.M. Two other females were taken a week later from the same host and have been given Cat. No. 49764, U.S.N.M.

Specific characters of female.—Cephalothorax somewhat obcordate in dorsal outline, the apex being formed by the two anterior processes, the lobes by the posterolateral processes, while between these lobes the posterior margin is deeply invaginated. The two anterior processes are relatively larger than in *ferox*, are directed diagonally forward and downward, and are not produced ventrally. Their flattened inner surfaces entirely cover the proboscis and mouth parts. A pair of lateral processes project from the sides of the cephalothorax behind this frontal pair, and the bases of the two pairs are fused. The dorsal portion of the head is greatly inflated and sends out on either side diagonally backward and upward a large spherical process. The two do not quite meet on the midline dorsally, leaving a deep sinus between them. The ventral processes, instead of being diagonal as in *ferox*, are at right angles to the head axis and are fused across the midline, so that they appear as one. On the ventral surface of these processes is found on either side another jointed, finger-like proturbance similar to those in *ferox*. It, too, is solid, contains what appear to be muscles, and is split at the tip. It is on the postero-ventral instead of the postero-dorsal surface of the process, but this difference in position is probably due to the differences in the processes themselves. Whether these protuberances are really migrated appendages can only be determined by following their development, but they certainly resemble appendages. In *Sphyrion* the maxillipeds remain close to the midline, but are almost concealed by a pair of fused ventral processes just in front of them, and we might suppose that here similar processes by an increased development have separated the appendages and carried them farther away from the midline.

The mouth tube and maxillae are similar to those of *ferox*, but the rami of the maxillae are much smaller and each is tipped with a tiny spine. The second maxillae are large and stout and are tipped with a sort of chela formed of two rounded knobs.

The neck is wrinkled for its entire length and is the same diameter throughout, which is relatively nearly twice that of *ferox*. And like the latter it shows the segmentation by breaks in the longitudinal muscles and by grooves on the lateral margins. The trunk is obcordate, the neck joining its apex, and is flattened dorsoventrally, the thickness being less than a third of the width. It is as wide as long, but is made up of the same parts as in *ferox*, where the length was several times the width. Its surface is perfectly smooth, the dorsoventral muscles separating the coils of the oviducts being apparently too weak to produce any pits. The posterior processes are sausage shaped, slightly widened along the center, where they become a third of the width of the trunk. They are a fourth longer than the trunk, but are only a trifle more than half the length of the egg strings. The latter are the same diameter as the processes and are bluntly rounded at the tips. The eggs are arranged in 9 or 10 rows, with 20 to 25 eggs in each row.

The minute abdomen is set into the sinus of the posterior margin of the trunk and can be recognized only by the break in the longitudinal musculature and by the large anal laminae.

Internally the cement glands occupy the posterior corners of the trunk; they are short, somewhat curved, and about three times as long as wide. In one of the females the cement glands showed a fairly regular segmentation, but in all the others there were no indications of it. The ovaries and oviducts are arranged as in *ferox*, the convolutions of the oviducts when the eggs are fully ripe extending into the fourth segment. Chitinogen tissue fills the entire cavity of the posterior processes, but is not as abundant in the trunk and neck.

Color, lobes of the head a deep crimson, especially the posterior ones, the red set off with black around the tips of the lobes. Bases of the lobes, the central portion of the head, and the anterior neck a pale yellow; remainder of neck a bright red, deepening toward the trunk, close to which it becomes almost black. Trunk varying in different specimens, largely due to the difference in the development of the eggs, sometimes dull yellow, yellowish white, pink, or even a bright orange. Posterior processes a light gray or grayish white; egg strings creamy white, changing to lavender with development.

Total length, including posterior processes, 28 mm. Head, 3.50 mm. long, 4 mm. wide. Neck, 16 mm. long, 1 mm. wide. Trunk, 3 mm. long and wide. Posterior processes, 4 mm. long, 1 mm. wide. Egg strings, 7.50 mm. long, 1 mm. wide.

(*versicolor*, variegated in color.)

Specific characters of male.—Cephalothorax two-fifths longer than the rest of the body, with a well-rounded carapace; one free thorax segment, the rest of the body fused without traces of segmentation. Posterior processes shorter than in the *ferox* male, but ending in sharp setae. First antennae indistinctly three-jointed and tipped with two setae; second pair two-jointed, the terminal joint bifurcate, the endopod armed with two setae, the exopod ending in a chela. First maxillae uniramose, one-jointed, and ending in three stout spines; second maxillae consisting of a stout joint tipped with a strong curved claw; maxillipeds with basal joints swollen and fused across the midline, the second and third joints separate, the third joint terminated by a strong chela made up of two claws of nearly equal size, the outer one with an accessory spine at its base. Testes, sperm ducts, and spermatophore receptacles like those in *ferox*.

Total length, 1.80 mm. Diameter of cephalothorax, 0.45 mm. Diameter of body, 0.35 mm.

Remarks.—This species was always found at the corner of the first gill arch in the floor of the mouth. Two may be found in the same fish, one on either side, but no more than this and never at any other spot. The head and long neck are buried in the tissues the same as *ferox*, and are surrounded by a sheath of tough membrane.

PERIPLEXIS, new genus.

Generic characters of female.—Cephalothorax soft, cylindrical and transversely wrinkled; neck much narrower than the cephalothorax, fully chitinized, intricately bent and twisted, and armed along at least the anterior half of its length with numerous short chitin horns and processes; enlarged posteriorly and joined to the genital segment at the center of the anterior end. Trunk elongate, cordate, flattened dorsoventrally, with rows of shallow pits on the dorsal and ventral surfaces as in *Rebelula;* no posterior lateral lobes; genital processes spherical and close together, their bases joined across the midline. Abdomen spherical and minute, attached ventrally to the bases of the genital processes; posterior processes attached in the groove between the abdomen and the genital segment on the dorsal surface; each made up of three large lobes flattened together. Egg strings two-thirds as wide as the posterior processes and longer than the trunk. Head squarely truncated anteriorly and surrounded by two crescentic pads; rudiments of first and second antennae; a retractile mouth tube with rudiments of one pair of maxillae. Male unknown.

Type of the genus.—Periplexis lobodes, monotypic.

(Περιπλέξης, entanglement, alluding to the twisted neck.)

PERIPLEXIS LOBODES, new species.

Plate 59, figs. 77–80.

Host and record of specimens.—A single female with empty egg cases was obtained by the Bureau of Fisheries steamer *Albatross* off the coast of New Jersey in 1883 from *Alepocephalus agassizii*, a deep-sea fish captured at a depth of 1,000 fathoms. The head and neck of the parasite were buried in the flesh of its host alongside the dorsal fin. This female has received Cat. No. 49757, U.S.N.M., and becomes the type of the new species.

Specific characters of female.—In addition to the generic characters already given the cephalothorax is a little wider anteriorly and the truncated anterior end is curved over ventrally. The two excellent figures drawn by A. H. Baldwin give a good idea of the very complex twisting of the neck and its armature, which are so intricate as to baffle any description. None of the processes or horns are branched, but some of them reach a length of 5 or 6 mm., and they are all, as well as the neck itself, covered with a thick chitin skin. Behind these horns the neck enlarges gradually to a diameter of 3 millimeters and joins the trunk in line with the axis of the latter. The outline of the trunk is that of an acorn, the sides nearly parallel, contracted to the diameter of the neck where it joins the latter, and with rounded posterior corners. The width is three-fifths and the thickness two-fifths of the length; the surface is smooth and shiny save for the rows of depressions; dorsally there are seven of these pits in a row, but ventrally there are four.

The genital processes are split ventrally into three lobes, which overhang the bases of the egg strings. The egg cases are empty, but one of them is entire save for the perforations through which the larvae escaped, thus giving the size. The abdomen is relatively very small and thoroughly fused with the trunk. The posterior processes are unlike anything that has ever been reported in the parasitic copepods. Where the process is attached it is narrowed into a short, threadlike neck; this enlarges abruptly into three large lobes whose adjacent surfaces are pressed together and flattened; each lobe is two-fifths as wide and the three together are half as long as the trunk.

The two crescentic pads form a thickened rim around the truncated anterior end of the head, their bluntly rounded ends meeting dorsally and ventrally on the midline. The first antennae are small spherical knobs on the dorsal surface of the head, behind the bases of the second pair. The latter are more or less spherical and somewhat elongated along the ventral surface, and do not show any chelate processes. In front of the bases of these antennae is the mouth tube, which is raised a little above the surrounding surface and carries on its sides a single pair of maxillae in the form of small processes tipped with a spine.

The whole structure of the head is so blind that if it were not for the suggestion obtained from a study of the immature specimens of *Sphyrion lumpi*, and the other genera here presented, it would be almost incapable of interpretation; but analogy leaves little room for doubt.

Color (preserved material), cephalothorax and posterior processes a clear yellow; neck cinnamon brown; trunk dark gray.

Total length, including posterior processes, 60 mm. Cephalothorax 9 mm. long, 4 mm. wide. Neck 3 mm. wide posteriorly. Trunk 25 mm. long, 15 mm. wide, 10 mm. thick. Posterior processes 12 mm. long, 6 mm. wide. Egg strings 40 mm. long, 5 mm. wide. If the neck and cephalothorax were straightened it would add 15 or 20 mm. to the length.

(λοβώδης, lobed like a pod, alluding to the posterior processes.)

Remarks.—In spite of the fact that there is but a single specimen, this new species presents much of interest. It can be recognized at once by the posterior processes and the intricately twisted neck. The latter furnishes new evidence of the extent to which the burrowing and anchorage of the parasite in the tissues of its host can modify its morphology. In the other genera we have found all kinds of processes and horns. Here there is not only an extra profusion of anchor processes, but they are combined with flexures and foldings of the neck itself. Nothing short of a charge of dynamite could ever loosen this parasite's hold upon its host. In the posterior processes an increase of surface in contact with the water is obtained not by branching nor by the attachment of numerous cylinders or cones, as in other genera, but by a large increase in the diameter of the process itself. Since there was but a single specimen, nothing could be ascertained with reference to the internal anatomy; but the presence of the rows of pits on both dorsal and ventral surfaces proves the existence of dorsoventral muscle bundles similar to those in the other genera. Accordingly, we may assume that there is a corresponding similarity in other details also.

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1871. **van Beneden, P. J.** Note sur un Crustacé parasite nouveau, avec l'énumeration des espèces de cette classe qu'on observe sur les poissons du littoral de Belgique. Bull. Acad. Belgique, vol. 18, pp. 286–290, one unnumbered plate.

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1865. **Cornalia, E.** Sulla Lophoura edwardsii di Kölliker osservazioni zoologiche e anatomiche. Atti Soc. Ital. Sci. Nat., vol. 9, pp. 1–10, pl. 1.

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1871. **Cunningham, R. O.** Notes on the Reptiles, Amphibia, Fishes, Mollusca, and Crustacea obtained during the voyage of H. M. S. *Nassau*, 1866–1869. Trans. Linn. Soc. London, vol. 27, pp. 465–501, pls. 58 and 59.

Described (p. 501) and figured (pl. 59, fig. 12), *Sphyrion kingi*, n. sp.

1830. **Cuvier, G. L.** Le Règne Animal. 2nd ed., Paris.

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1829. **Guérin-Meneville, F. E.** Iconographie du Règne Animal. Published in livraisons, Paris, 1829–1844.

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1853. **Kölliker, A.** Bericht über einige im Herbste 1852 in Messina angestellte vergleichend anatomische Untersuchungen. Zeit. für wiss. Zool., vol. 4, pp. 299–370.

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1845. **Krøyer, H.** Danmarks Fiske. Kjøbenhavn.

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1913. Scott, T. and A. The British Parasitic Copepoda. London, printed for the Ray Society, 2 vols.

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1900. Thor, S. Description préliminaire d'une nouvelle espèce du genre Sphyrion Cuv. (Sphyrion australicus, n. sp.) d'Australie comparée à Sphyrion laevis Quoy et Gaimard. Ann. Sci. Nat. Zool., ser. 8, vol. 11, pp. 277–282, pls. 17 and 18.

EXPLANATION OF THE PLATES.

Plate 50.

Sphyrion lumpi.

Fig. 1. Ventral view of adult female. Fig. 2. Dorsal view of same. Fig. 3. Dorsal view of head, enlarged. Fig. 4. Dorsal view of third development stage. Fig. 5. Ventral view of same. Fig. 6. Side view of same. Fig. 7. Dorsal view of posterior processes of same. Fig. 8. First antenna of fourth development stage. Fig. 9. Tip of second antenna of same. Fig. 10. Maxilliped. Fig. 11. First swimming leg. Fig. 12. Ventral view of head.

Plate 51.

Sphyrion lumpi (continued).

Fig. 13. Ventral view of entire head of adult female. Fig. 14. Anterior portion of head magnified to show antennae and mouth parts; an^1 and an^2 antennae, mx^1 and mx^2 maxillae, *mxp.* maxillipeds. Fig. 15. Ventral view of youngest developmental stage obtained. Fig. 16. Dorsal view of same. Fig. 17. Dorsal view of posterior processes, just starting. Fig. 18. Dorsal view of second developmental stage. Fig. 19. Ventral view of same. Fig. 20. Dorsal view of posterior processes farther developed. Fig. 21. Second maxilla of male. Fig. 22. Maxilliped of same.

PLATE 52.

Sphyrion lumpi (continued).

Fig. 23. Side view of male; *sp.* sperm duct, *sr.* spermatophore receptacle, *t.* testis. Fig. 24. First antenna of male. Fig. 25. Second antenna of same. Fig. 26. Mouth tube and first maxilla of same. Fig. 27. First antenna of adult female. Fig. 28. Second antenna of same. Fig. 29. Second maxilla. Fig. 30. Dorsal view of trunk of youngest developmental stage. Fig. 31. Dorsal view of trunk of third developmental stage. Fig. 32. Dorsal view of trunk of adult female. In the last three figures *cl.* cement gland, *ds.* dorsoventral muscles, *ig.* processes of the intestine, just starting in fig. 30, partly formed in fig. 31, and fully developed in fig. 32, *in.* intestine, *og.* ovary, *rc.* muscles controlling the rectum.

PLATE 53.

Fig. 33. Ventral view of *Rebelula gracilis.* Fig. 34. Ventral view of *R. bouvieri.* Fig. 35. Side view of head of same, enlarged. Fig. 36. Dorsal view of head. Fig. 37. Ventral view of head. Fig. 38. Head viewed from the anterior end. Fig. 39. First (upper) and second antennae of male of *R. bouvieri.* Fig. 40. Maxilliped of same.

PLATE 54.

Fig. 41. Side view of male of *Rebelula bouvieri; cl.* cement gland, *eg.* excretory gland, *sp.* sperm duct, *sr.* spermatophore receptacle, *t.* testis. Fig. 42. Side view of head of adult female of *R. bouvieri*, *an.*[1] antennae, *mx.*[2] maxillae, and *mxp.* maxilliped. Fig. 43. Posterior end of trunk. Fig. 44. Dorsal view of trunk; *cl.* cement gland, *ds.* dorsoventral muscles, *in.* intestine, *ov.* ovary. Fig. 45. Ventral view of head of adult female of *Rebelula gracilis.*

PLATE 55.

Rebelula cornuta.

Fig. 46. Adult female. Fig. 47. Side view of male; *cl.* cement gland, *eg.* excretory gland, *sp.* sperm duct, *sr.* spermatophore receptacle, *t.* testis. Fig. 48. Ventral view of male. Fig. 49. First antenna. Fig. 50. Second antenna. Fig. 51. Mouth tube and first maxillae. Fig. 52. Second maxilla. Fig. 53, Maxilliped.

PLATE 56.

Paeon ferox.

Fig. 54. Adult female. Fig. 55. Ventral view of head, enlarged. Fig. 56. Dorsal view of head. Fig. 57. Side view of head. Fig. 58. Ventral view of trunk; *cl.* cement gland, *ds.* dorsoventral muscles, *eg.* eggs, *ms.* longitudinal muscles, *ov.* ovary. Fig. 59. Side view of male.

PLATE 57.

Paeon ferox (continued) and *P. versicolor.*

Fig. 60. Dorsal view of mouth and antennae of male; *an.*[1] and *an.*[2], antennae. Fig. 61. Ventral view of same. Fig. 62. Dorsal surface of trunk of *P. versicolor; cl.* cement gland, *ds.* dorsoventral muscles, *eg.* eggs, *in.* intestine, *ms.* longitudinal muscles, *ov.* ovary. Fig. 63. The migrated second antenna (?) of *P. ferox.*

Fig. 64. The same from another specimen. Fig. 65. The same from *P. versicolor*. Fig. 66. Maxilliped of *P. ferox*. Fig. 67. The same of *P. versicolor*.

PLATE 58.

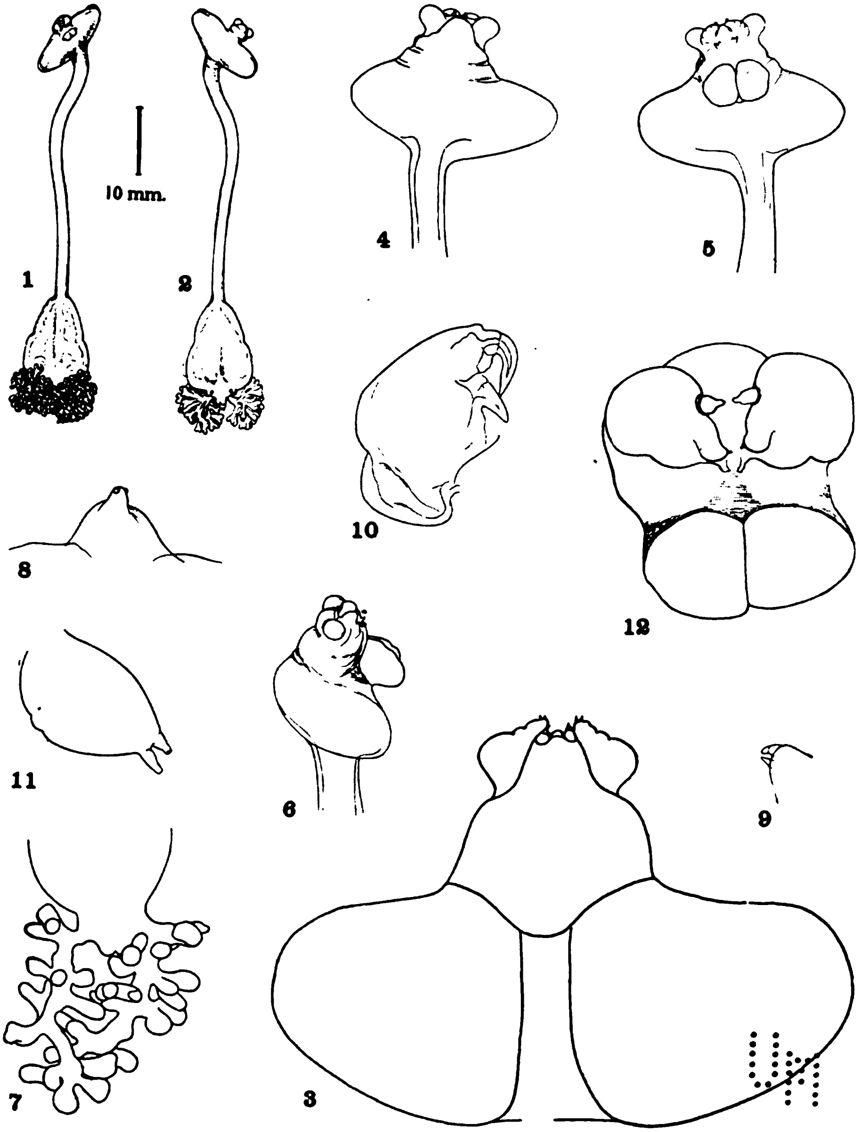
Paeon versicolor.

Figs. 68 and 69. Two views of adult female (owing to torsion these views are partly dorsal, partly ventral, and partly lateral). Fig. 70. Ventral view of head, enlarged. Fig. 71. Mouth tube, and first maxillae. Fig. 72. Side view of male. Fig. 73. Second maxilla. Fig. 74. Maxilliped.

PLATE 59.

Fig. 75. Side view of antennae and mouth parts of male of *P. versicolor*; *an* antennae, *md.* mandible, *mo.* mouth, *mx.* maxilla. Fig. 76. Lateral view of head of female of *P. versicolor*. Fig. 77. Ventral view of adult female of *Periplexis lobodes*. Fig. 78. Dorsal view of same. Fig. 79. Ventral view of head, enlarged. Fig. 80. Dorsal view of same.

Figs. 1, 2, 33, and 34 were drawn by J. H. Blake. Figs. 77 and 78 were drawn by A. H. Baldwin, while figs. 4 to 11, 15 to 20, 36, 37, 42, and 43 are by Richard Rathbun.



FEMALE OF SPHYRION LUMPI.

FOR EXPLANATION OF PLATE SEE PAGE 602.

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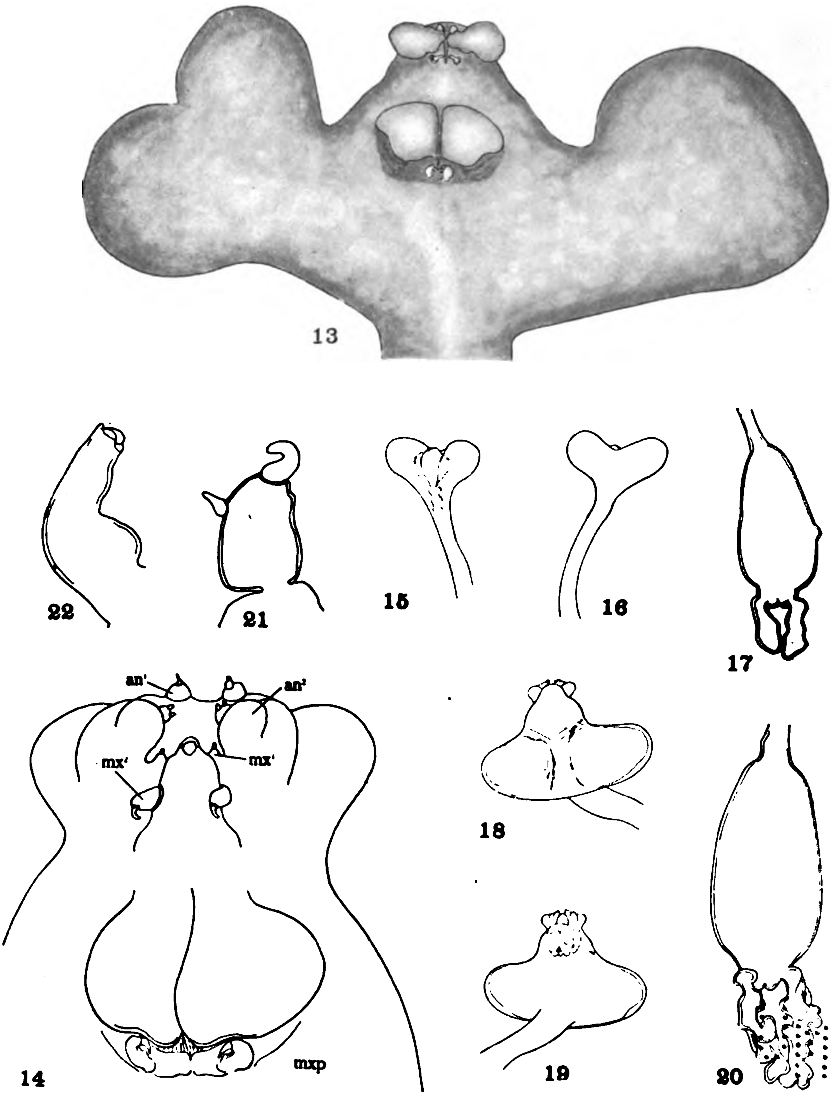
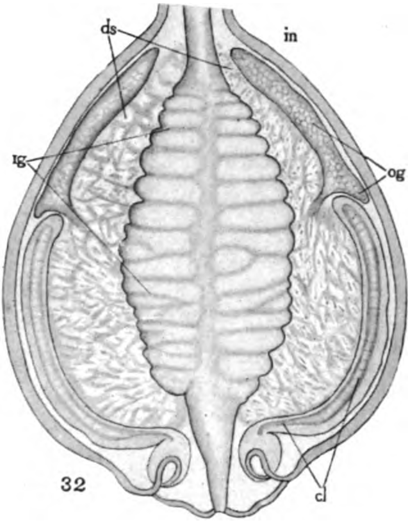


FULLY DEVELOPED AND YOUNG FEMALES OF SPHYRION LUMPI.

FOR EXPLANATION OF PLATE SEE PAGE 602.



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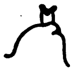

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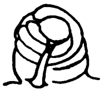

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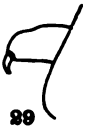

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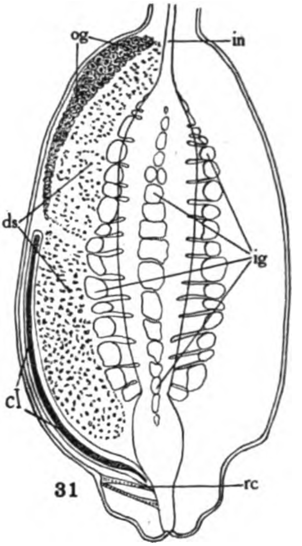

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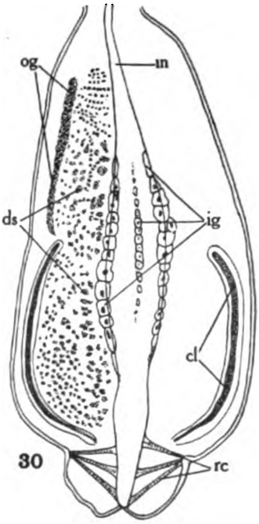

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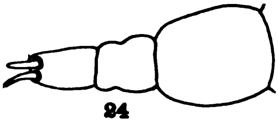

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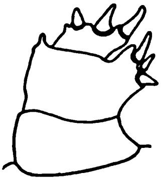

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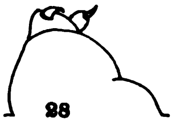

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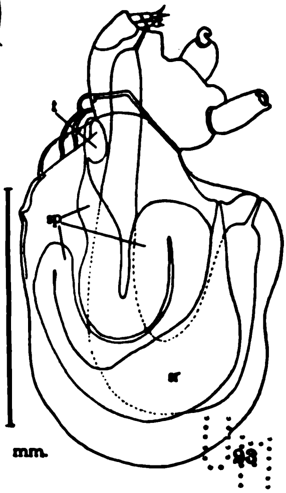

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MALE AND FEMALE OF SPHYRION LUMPI.

FOR EXPLANATION OF PLATE SEE PAGE 603.

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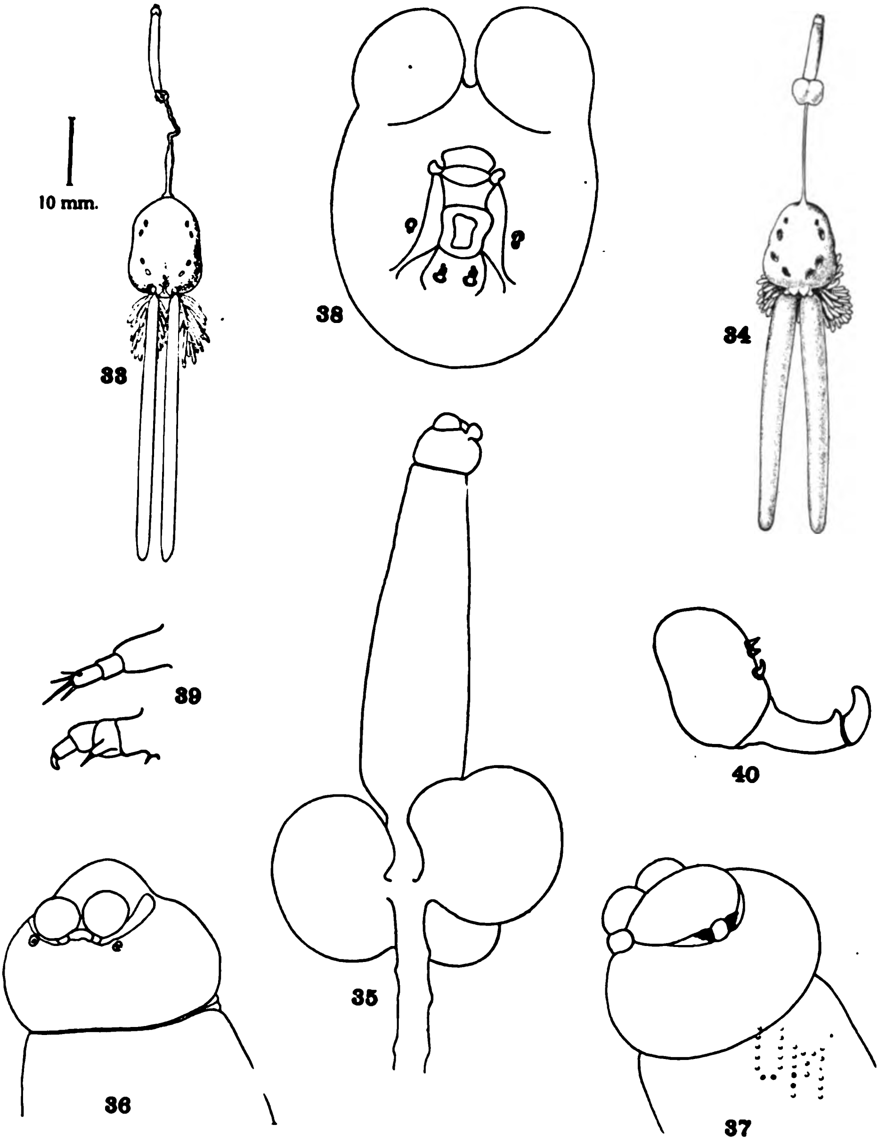
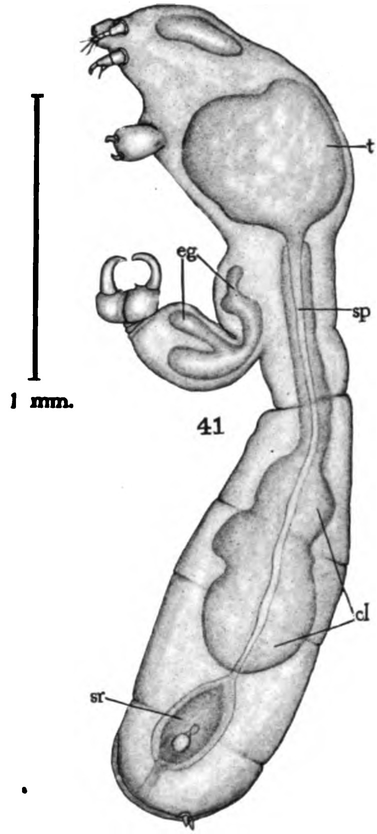


FEMALES OF REBELULA GRACILIS AND R. BOUVIERI.

FOR EXPLANATION OF PLATE SEE PAGE 603.



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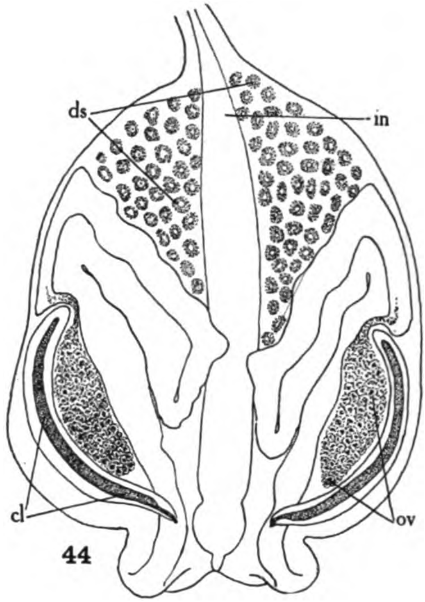

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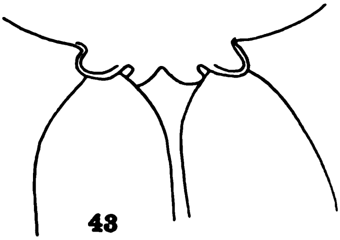

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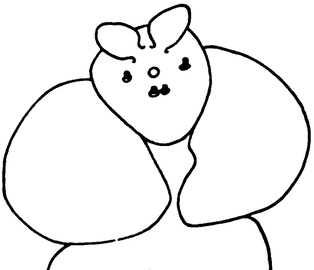

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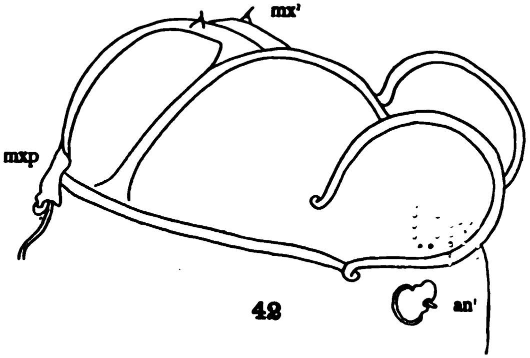

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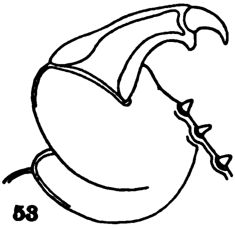
MALE AND FEMALE OF REBELULA BOUVIERI.

FOR EXPLANATION OF PLATE SEE PAGE 603.



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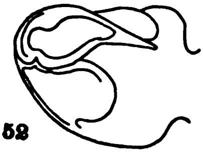

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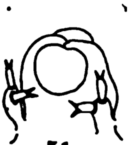

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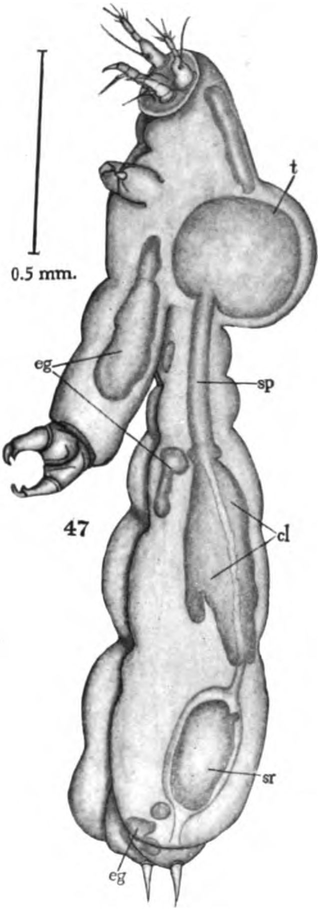

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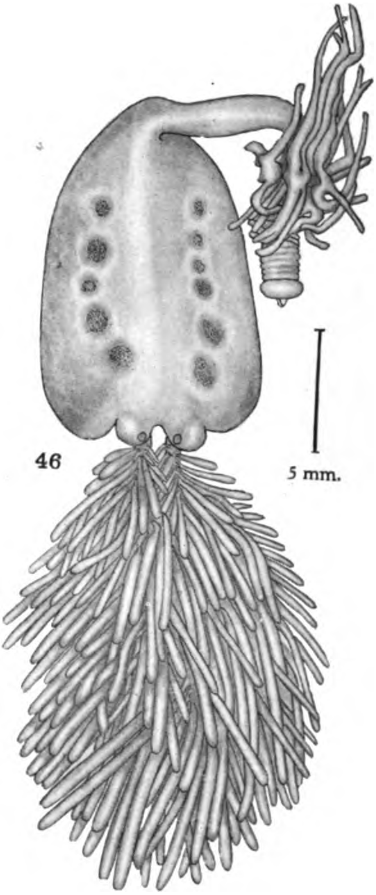

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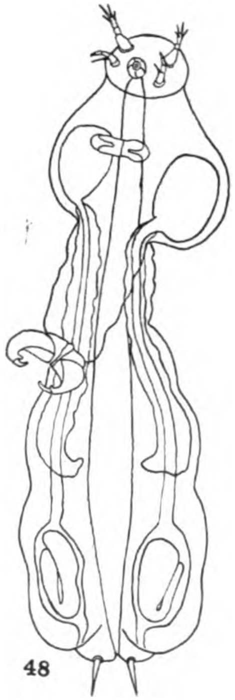

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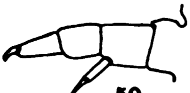

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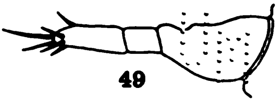

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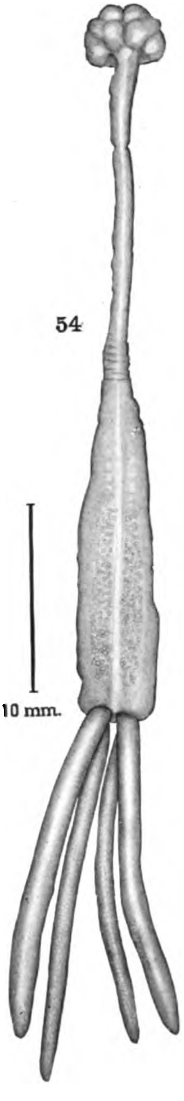
MALE AND FEMALE OF REBELULA CORNUTA.

FOR EXPLANATION OF PLATE SEE PAGE 603.



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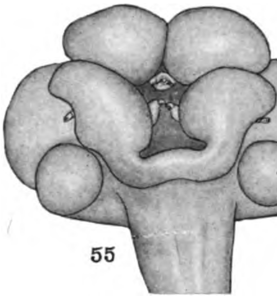

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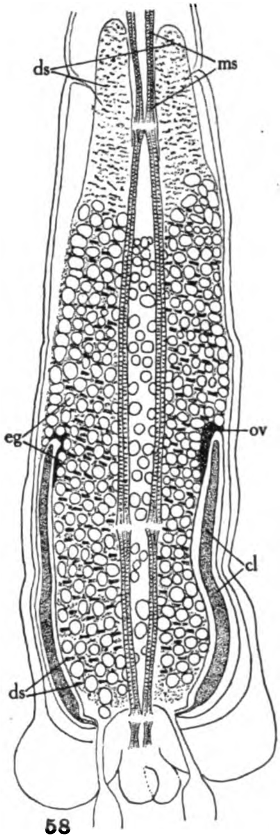

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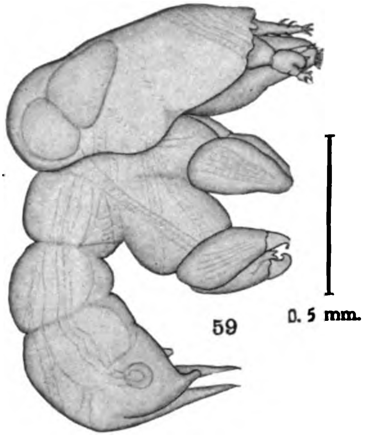

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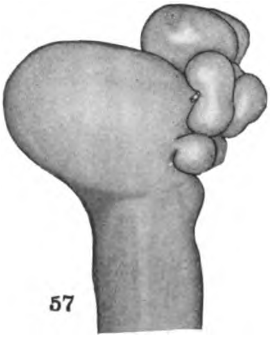

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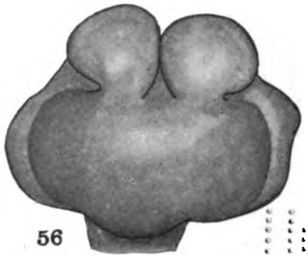

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MALE AND FEMALE OF PAEON FEROX.

FOR EXPLANATION OF PLATE SEE PAGE 603.

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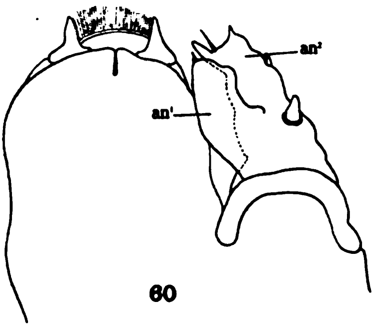

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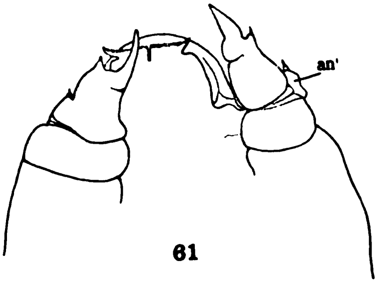

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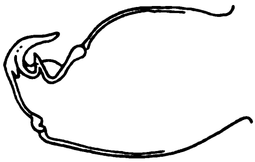

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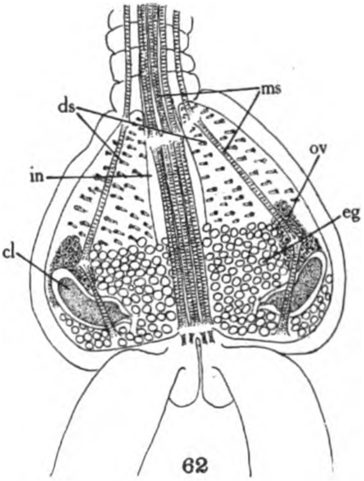

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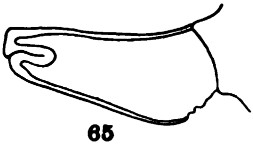

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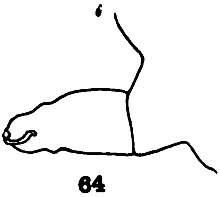

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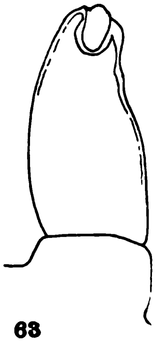

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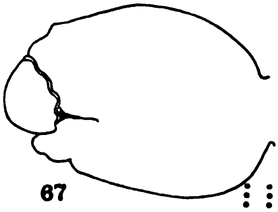

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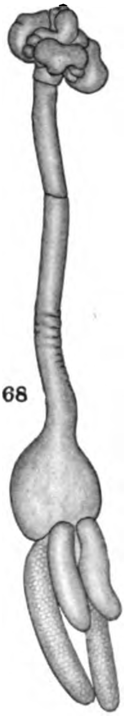
MALE OF PAEON FEROX AND FEMALE OF P. VERSICOLOR.

FOR EXPLANATION OF PLATE SEE PAGES 603 AND 604.



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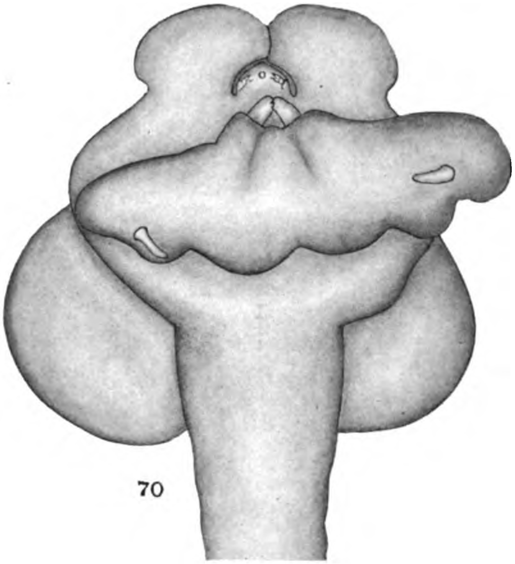

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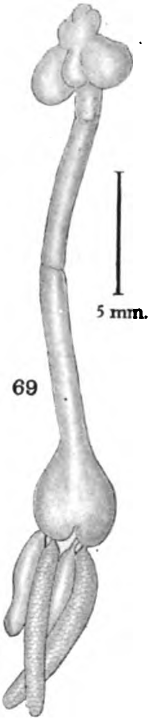

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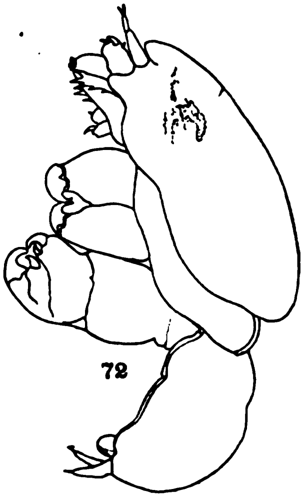

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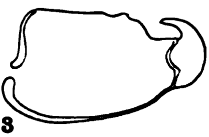

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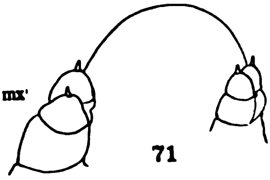

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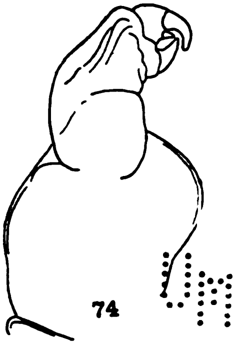

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MALE AND FEMALE OF PAEON VERSICOLOR.

FOR EXPLANATION OF PLATE SEE PAGE 604.

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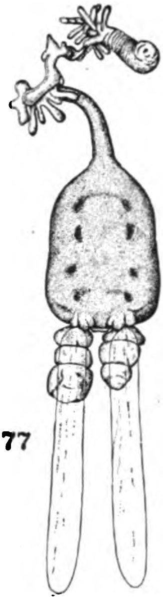

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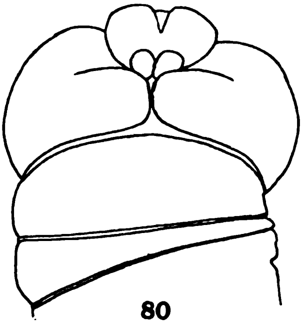

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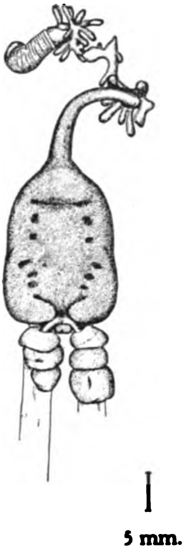

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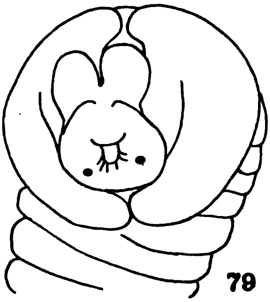

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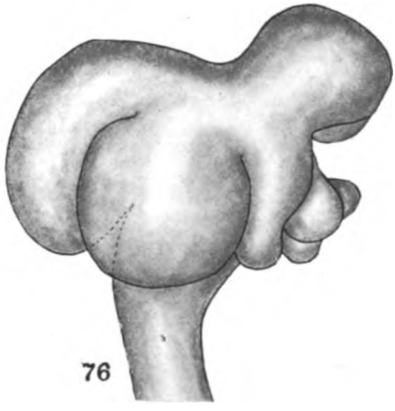

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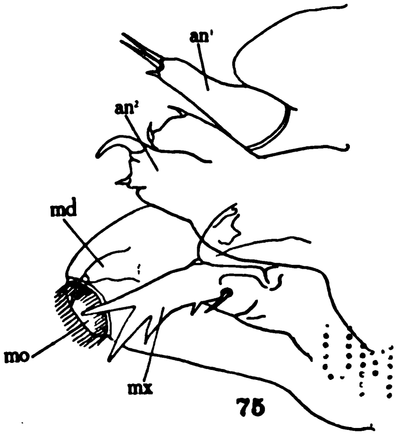

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FEMALE OF PERIPLEXIS LOBODES AND MALE AND FEMALE OF PAEON VERSICOLOR.

FOR EXPLANATION OF PLATE SEE PAGE 604.

HU

DESCRIPTIVE CATALOGUE OF THE COLLECTION OF ECCLESIASTICAL ART IN THE UNITED STATES NATIONAL MUSEUM.

By I. M. Casanowicz.

Assistant Curator, Division of Old World Archeology, United States National Museum.

INTRODUCTION.

The collection of Ecclesiastical Art forms part of the section of the History of Religions which is on exhibition in the old building of the National Museum. It comprises church furnitures, as far as they are embellished by art, appurtenances of the public worship, and objects used in individual devotions and on special occasions, and is obviously confined to the illustration of the ceremonies and usages of the ritual branches of Christendom—that is, the Roman Catholic and eastern churches. Of the former the collection is quite representative, occupying an alcove of three cases. Of the eastern churches there is a small collection of the Greek Orthodox Church, mostly of the Russian division of that denomination, and of the Armenian Church, filling one case. Much material of the collection remains, for lack of exhibition space, in storage.

The description is accordingly divided into—I. Ecclesiastical Art of the Roman Catholic Church; II. Of the Eastern Church; and III. Of the Armenian Church.

I. ECCLESIASTICAL ART OF THE ROMAN CATHOLIC CHURCH.

PARAPHERNALIA OF THE CHURCH SERVICES.

SERVICE OF THE MASS.

The service of the mass is, according to the teaching of the Catholic Church, a perpetual repetition of the sacrifice of Christ on the cross. The bread and wine are, by the words of consecration pronounced by the priest, changed into the real body and blood of Christ (transsubstantiation), and Christ thus offers himself each time anew through the priest, his representative on earth, and is partaken of in the communion.

The liturgy of the mass consists of extracts from the Scriptures and prayers, some of which are always recited, while others vary according to the season or the purpose for which the mass is offered, and is, in the larger portion of the Roman Catholic Church, in the Latin language.

The requisites for the celebration of mass are: An altar, of which at least the part of the table upon which the chalice and paten rest during the service must be of stone, in which relics of the martyrs are inclosed (with reference to Revelation vi, 9), and must be consecrated by a bishop. The altar is covered with three linen cloths (symbolizing the linen cloths in which Christ's body was shrouded, as the altar represents his tomb), blessed by a bishop, or by a priest empowered by him. Midway of the altar and fixed to its base is the tabernacle, a small chest, more or less decorated, which holds the consecrated hosts in their repositories, the cibory and pyx, for the communion of the laymen and for the sick, and a light is always kept burning in front of it. Upon the altar is a crucifix. Two candles are lighted during a low mass, which is one recited by the priest without chant, and six during a high mass, which is one accompanied by music and incense and attended by a deacon and subdeacon.

The sacred vessels used in the service of the mass are the chalice, in which the wine, mixed with water, is consecrated, and the paten, a small plate upon which the host, in form of a cake of unleavened wheat bread, about 2 inches in diameter, rests during a portion of the mass. The appurtenances of the chalice and paten are the corporal, a square piece of cloth, upon which the host and chalice are placed, and which when not in use is held in the burse, a case covered with the same material as the priest's vestments; the purificator, a piece of linen used for wiping out the chalice; the pall, a stiff piece of linen, about 5 inches square, used to cover the chalice; and the veil, a square piece of the same material as the priest's vestments, with which the chalice is covered before offertory and after communion.

Mass may be celebrated only in the morning, and the celebrant must be fasting.

1. *High altar.*—Made of wood and constructed in a combination of Gothic, Renaissance, and Rococo styles, and probably dates from the seventeenth century. It is adorned with two oil paintings. The lower represents the assumption of Mary into heaven. Mary, in a blue cloak with yellow borders, is ascending to heaven surrounded by fluttering cherubs, while underneath the apostles with uplifted faces and raised hands are gazing after her. The Assumption of the Virgin is the principal feast celebrated in her honor, and is observed on August 15. The upper painting represents John the Evangelist in a red cloak holding the chalice of the Lord's Supper. Height, 15

feet; width, 7 feet 3 inches.—Hildesheim, Germany. (Cat. No. 207743, U.S.N.M.)

2. *Altar.*—Made of wood and adorned with an oil painting representing the Holy Family—that is, Joseph, Mary, and the Infant Jesus. Probably dating from the seventeenth century. Height, 7 feet 2½ inches; width, 4 feet 2¼ inches.—Hildesheim, Germany. (Plate 60, Cat. No. 207744, U.S.N.M.)

3. *Altar cloth.*—Made of linen, with lace borders and embroidered edges. Length, 62 inches; width, 29 inches.—Italy. (Cat. No. 179015, U.S.N.M.)

4. *Fragments of gilded carvings of an altar.*—Including six oval panel paintings, measuring each 10¼ by 8⅛ inches, representing the Virgin Mary, the archangel Gabriel, and the four Evangelists.—Italy. (Cat. No. 179013, U.S.N.M.)

5. *Bronze candlestick.*—With a point on top upon which to stick the candle. Height, 13 inches.—Italy. (Plate 61, fig. 1, Cat. No. 152230, U.S.N.M.)

6. *Bishop's candlestick.*—Made of white metal. Used to light the bishop while reciting the prayers of thanksgiving after mass. Height, 2½ inches; length, 10¾ inches.—Italy. (Plate 61, fig. 2, Cat. No. 179034, U.S.N.M.)

7. *Pair of candlesticks.*—Made of wood, carved and gilded. Height, 12½ inches.—Spain. (Plate 61, fig. 3, Cat. No. 178863, U.S.N.M.)

8–9. *Altar lamps.*—Made of white metal in chased work. In front of the tabernacle of the altar in which a consecrated host is preserved a lamp filled with olive oil is always kept burning. It is usually suspended by a chain from the ceiling of the church in front of the tabernacle.—Italy. (Plate 62, figs. 1 and 4, Cat. Nos. 179022–023, U.S.N.M.)

10. *Large altar lamp.*—Made of brass, hammered work. Diameter of bowl, 10½ inches.—Italy. (Cat. No. 179024, U.S.N.M.)

11. *Large altar lamp.*—Made of white metal, repoussé work. Diameter, 12 inches.—Italy. (Cat. No. 199026, U.S.N.M.)

12–13. *Small altar lamps.*—Made of white metal.—Italy. (Cat. No. 179023, U.S.N.M.)

14. *Altar lamp.*—Made of brass.—Madrid, Spain. (Cat. No. 167082, U.S.N.M.)

15. *Small lamp.*—Made of brass, with loops for suspension. Height, 8¾ inches; diameters, 2⅞ and 2¼ inches.—Italy. (Cat. No. 152235, U.S.N.M.)

16–17.—*Censers or thuribles.*—Made of white metal, openwork. The censer consists of a cup or bowl, which is provided with a movable pan for holding ignited charcoal, upon which the incense is put, a lid or covering and four chains about 3 feet in length, three of which unite the bowl to a circular disk, while the fourth is used for raising the lid to which one end of it is attached, the other passing through a hole in the disk and terminating in a ring. Incense is used at a solemn high mass, at vespers, benediction, at the obsequies of the dead, and at certain other ceremonies and blessings. The custom of burning incense in religious ceremonies is widespread. Besides the fragrance, it is a symbol of prayer (see Psalms cxli, 2; Revelation v, 8; viii, 3).—Italy. (Plate 62, figs. 2 and 3, Cat. Nos. 152233 and 179022, U.S.N.M.)

18. *Censer.*—Made of white metal.—Italy. (Cat. No. 179023, U.S.N.M.)

19. *Censer.*—Made of brass.—Italy. (Cat. No. 179023, U.S.N.M.)

20. *Censer.*—Made of brass, openwork.—Italy. (Cat. No. 179025, U.S.N.M.)

21–22. *Incense boat.*—Made of white metal, repoussé work. Before putting the incense from the boat, or nave, into the censer, the priest makes the sign of the cross and pronounces a blessing over it.—Italy. (Plate 63, figs. 1 and 4, Cat. Nos. 179021–2, U.S.N.M.)

23. *Incense boat.*—Made of white metal, chased and repoussé work Height, 4½ inches; length, 6½ inches.—Italy. (Cat. No. 152234, U.S.N.M.)

24–25. *Holy water vessel and sprinkler.*—The vessel is of white metal with fluted sides in repoussé work. The sprinkler is of brass. On Sunday, at the beginning of high mass, the priest sprinkles the people with water, into which salt has been thrown and over which various prayers and benedictions have been pronounced, reciting Psalm li, 9. The rite is therefore called *Asperges*, from the first word of the verse in Latin. It is symbolical of the purification of the soul, and it is also believed to be a means of grace, in virtue of the prayers and blessings pronounced over the water by the priest. Height, 5 inches; diameters, 5½ and 3 inches.—Italy. (Plate 63, figs. 2 and 3, Cat. No. 152228, U.S.N.M.)

26–27. *Chalice and paten.*—Made of silver, gilded. The chalice is in Renaissance style and is adorned with floral designs in chased work. The chalice, or at least its cup, in which the wine is consecrated, and the paten, upon which the host is placed, must be either of gold or of silver gilded. They are consecrated with prayer and anointing with the holy chrism, and after that must not be touched by a layman. Height of the chalice, 8½ inches; diameters, 5¼ and 3⅜ inches; diameter of the paten, 6¼ inches.—Italy. (Plate 64, figs. 1 and 3, Cat. Nos. 179016–017, U.S.N.M.)

28. *Pair of cruets with tray.*—Made of glass. The stoppers of the cruets are in the form of a cross. Used for holding, respectively, the wine and water for the Eucharist.—Montclair, New Jersey. (Cat. No. 239069, U.S.N.M.) Gift of Rev. Joseph Mendl.

29. *Pair of cruets with tray.*—The same as the preceding number.—Ridgewood, New Jersey. (Cat. No. 239094, U.S.N.M.) Gift of Rev. P. T. Carew.

30. *Cibory.*—Made of silver, gilded, in form of a chalice, only wider and shallower in the cup, with a conical cover, surmounted by a cross. In the cibory are reserved the smaller hosts for the ordinary communicants and the sick. It is kept covered with a silken veil in the tabernacle of the altar. Height, 7 inches; diameters, 2½ and 2½ inches.—Italy. (Plate 65, fig. 1, Cat. No. 152227, U.S.N.M.)

31. *Pyx.*—Made of white metal in the same shape as the cibory, only smaller. Used for carrying the sacrament to the sick. Height, 3½ inches; diameters, 1⅝ and 1½ inches.—Italy. (Plate 65, fig. 4, Cat. No. 179030, U.S.N.M.)

32. *Brass vase.*—Made in form of an amphora with a conical cover. Probably used for holding the holy chrism, which is consecrated by the bishop on Thursday of the Holy Week ("Maundy Thursday"), and is used in the rites of baptism, confirmation, ordination, and coronation; in the consecration of churches, altar stones, chalices, and in blessing the baptismal water. The chrism of the Roman Catholic Church consists of a mixture of oil and balsam. The chrism of the Eastern Church contains, besides oil and balsam, 55 other ingredients, among which are red wine, orange and rose water, mastic, various gums, nuts, pepper, flowers, and ginger, and certain chemists of Constantinople are officially appointed to prepare it.[1] Height, 8¾ inches; diameter, 3 inches.—Italy. (Cat. No. 179020, U.S.N.M.)

33–34. *Silver cup and spoon.*—Probably used for handing out the holy chrism. Height of the cup, 3 inches; diameter, 1½ inches.—Seville, Spain. (Plate 65, figs. 5 and 6, Cat. No. 167049, U.S.N.M.)

ALTAR LINEN TEXTILES.

35–36. *Three corporals.*—Made of linen, with lace borders and an embroidered cross in the center. Upon the corporal the host and chalice are placed during celebration of the mass. Dimensions, 11½ by 9½ inches to 17 by 14 inches.—Italy. (Cat. No. 179002, U.S.N.M.)

37–38. *Two burses.*—Of green silk, with cross and borders of yellow silk and gold brocade. The burse is used to hold the corporal when not in use. Dimensions, 8½ and 9½ inches square.—Italy. (Cat. No. 179002, U.S.N.M.)

39. *Burse.*—Of yellow silk brocade with green border. Dimensions, 8 inches square.—Italy. (Cat. No. 179003, U.S.N.M.)

40. *Burse.*—Of black brocade, with cross and borders of white brocade. Dimensions, 8 inches square.—Italy. (Cat. No. 179004, U.S.N.M.)

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[1] See Adrian Fortescue, The Eastern Orthodox Church, London, 1916, p. 425.

41. *Pall.*—Made of linen, with a gold fringe, embroidered in silver and gold, with figures of chalice, host, burning hearts, and the instruments of the crucifixion. Used to cover the chalice. Dimensions, 5 inches square.—Italy. (Cat. No. 152232, U.S.N.M.)

42. *Pall.*—Made of linen, with lace fringe and red cross in the center.—Italy. (Cat. No. 179005, U.S.N.M.)

43–47. *Five puricators.*—Made of linen, with lace borders and embroidered cross in the center. Used for wiping out the chalice after the communion. Dimensions, 5 to 6¼ inches.—Italy. (Cat. No. 179007, U.S.N.M.)

48. *Veil.*—Of black brocade, with white borders and white cross in the center. The veil is used to cover the chalice before the offertory and after the communion. Dimensions, 18¼ inches square.—Italy. (Cat. No. 179004, U.S.N.M.)

49. *Veil.*—Of black brocade, with borders of yellow silk. Dimensions, 22¾ inches square.—Italy. (Cat. No. 179004, U.S.N.M.)

50. *Veil.*—Of purple silk, with borders of gold appliqué work and a cross within a circle of the same stuff. Dimensions, 22 inches square.—Italy. (Cat. No. 179005, U.S.N.M.)

51. *Veil.*—Of reticellar work in pale blue and white. In the center, IHS, which is the abbreviation of the Latin words *Jesus hominum salvator* (Jesus Saviour of Mankind), within a circle of rays, while the edges are adorned with floral designs. Dimensions, 24 inches square.—Italy. (Cat. No. 179006, U.S.N.M.)

52. *Laver.*—Made of brass, semicircular as to be fastened to the wall, with a crane at the bottom. Before vesting for the celebration of the mass the celebrant washes his hands in the sacristy to typify purity of heart and outer reverence for the sacred presence. During the mass he washes his hands after the offertory and communion at the altar. Height, 19 inches; width, 12½ inches.—Italy. (Cat. No. 179027, U.S.N.M.)

VESTMENTS OF THE MASS.

It is assumed by many authorities that the ecclesiastical vestments were evolved by a natural process from the ordinary costume of a Roman citizen of the first or second century of the Christian era. The vestments used in the celebration of the mass are:

(1) The cassock, a close-fitting robe reaching to the heels and buttoned all the way down in the front. It is the distinctive dress of clerics worn by them in their homes and at all sacred functions, and, in Catholic countries, at all times. The cassock of secular priests is black; of bishops and archbishops, purple or violet; of cardinals, red; of the pope, white.

(2) The amice or amict (from the Latin *amicire*, to cover, to clothe), also called humeral (from the Latin *humerus*, shoulder), a piece of linen, about 3 feet long by 2 feet wide, with a cross embroidered in

the middle of the upper edge, which the celebrant rests for a moment on his head, kissing the cross, and then spreads it over his shoulders with a prayer, binding it around the shoulders by means of strings at the upper corners of the cloth.

(3) The alb, a loosely fitting shirt-like robe of white linen (hence its name, from the Latin *albus*, white), reaching from head to foot. It is sometimes adorned with a border of lace or embroidery. It typifies the purity of life.

(4) The girdle, or cincture, a linen cord, the two ends of which terminate in large tassels, with which the priest binds the alb. It symbolizes continence and self-restraint.

(5) The maniple, a strip of cloth about 2 feet long, embroidered with three crosses, one in the middle and one at each of the extremities. It is worn on the left wrist, to which it is attached by a pin or string, hanging equally on both sides. It was originally a handkerchief or towel, and gradually developed into an ornamental and symbolical liturgical vestment. It signifies the rope with which Christ was bound and the tears of penitence to be wiped off.

(6) The stole (also called orarium), a long band of cloth, put around the neck and crossed on the breast, being held in this position by the girdle. It is also worn at the performance of any rite, as ministering the sacraments or blessing persons and things. It is the symbol of spiritual power and jurisdiction. It was perhaps developed from the scarf used to protect the neck.

(7) The chasuble (from Latin *casula*, the diminutive of *casa*, hut, because like a little house it covered the whole body). It is the outer or upper vestment which is last assumed. It is elliptical in cut, open on both sides and at the top, and as it is passed over the head to rest on the shoulders it reaches to the knees in front and a few inches lower behind. The material (gold cloth, brocade, silk, wool, linen) and color of the casuble, stole, and maniple, as also of the veil and burse, must be the same. The color of these vestments varies according to the season or the occasion of the mass. White or gold cloth is employed on the joyous feasts of Christ and Mary; red is used on Pentecost, in masses of the Holy Ghost, and of the apostles and martyrs; green is the color of the season, when there is no special feast; violet is used during Advent and Lent and on all penitential occasions; and black is used in masses of the dead and on Good Friday.

(8) The biretta, a stiff square cap with three or four prominences or projecting corners rising from its crown, and sometimes with a tassel in the middle where the corners meet. It is worn by the celebrant when he approaches the altar to say mass, and is, like the cassock, worn by the secular clergy generally.

The dalmatic (from Dalmatia, where the garment originated) is the distinctive vestment of the deacon when he assists at high mass, the service of benediction, and at processions. It resembles the chasuble, only it is not rounded at the extremities, but straight, and has wide sleeves and marked with two stripes. It has to conform in color to the vestments of the celebrant. The stole is worn by the deacon over the left shoulder and joined on the right side.

The tunic, which is the vestment of the subdeacon, does not differ much in form from the dalmatic.

Vestments of a mass celebrated by a bishop (pontifical mass).—The bishop, possessing the plentitude of priesthood, wears, when celebrating a pontifical mass, the vestments of all the ranks of the ministry. Peculiar to him are the rochet, a closely fitting garment of linen with sleeves, which he wears over the cassock, gloves, sandals, and the miter, a kind of a folding cap. It consists of two like parts, each stiffened by a lining and rising to a peak. These are sewn together on the sides, but are united above by a piece of material that can be folded together. Two lappets with fringes hang down from the back. According to the style, there is distinguished the Gothic miter, with straight lines and sharp point, and the Italian miter, with greater height and curved lines. The bishop also wears a pectoral cross, and a pontifical ring, and carries the crozier or pastoral staff, the symbol of authority and jurisdiction.

53. *Priests' mass vestments.*—Consisting of cassock, amice, alb, cincture, maniple, stole, chasuble, and biretta. The maniple, stole, and chasuble are made of red silk with floral designs in silver appliqué, and come from Italy; the cassock is a gift of the Rev. John Fenlon, St. Austens, Brookland, District of Columbia; the amice, alb, which is adorned with a border of embroidered floral designs, the cincture and biretta of velvet, are the gifts of the Rev. Joseph Mendl, Montclair, New Jersey. (Plate 66, Cat. Nos. 178996 and 239066–068, U.S.N.M.)

54. *Priests' mass vestments.*—Consisting of alb, maniple, stole, chasuble, and biretta. The maniple, stole, and chasuble, of flowered croisson silk in white and light green, come from Italy, the alb, of linen with lace border, and biretta, of velvet, are the gifts of the Rev. P. T. Carew, Ridgewood, New Jersey. (Plate 67, Cat. Nos. 178997 and 239090–093, U.S.N.M.)

55. *Maniple of white croisson silk.*—Embroidered in silk.—Italy. (Cat. No. 178999, U.S.N.M.)

56. *Maniple of purple croisson silk brocade.*—Italy. (Cat. No. 178999, U.S.N.M.)

57. *Maniple of white satin brocade.*—With borders and crosses in silver and gold appliqué.—Italy. (Cat. No. 178999, U.S.N.M.)

58. *Maniple of croisson silk brocade.*—With borders and crosses in yellow silk brocade.—Italy. (Cat. No. 178999, U.S.N.M.)

59. *Maniple of green silk and silver brocade.*—Italy. (Cat. No. 178999, U.S.N.M.)

60. *Maniple of white croisson silk brocade.*—With borders and crosses in gold lace.—Italy. (Cat. No. 178999, U.S.N.M.)

61. *Maniple of red satin.*—With crosses of yellow silk bordered with gold thread and the ends of the bars of the crosses terminating in fleurs-de-lis.—Italy. (Cat. No. 179000, U.S.N.M.)

62. *Maniple of Rosa silk brocade.*—With borders and crosses in yellow silk brocade.—Italy. (Cat. No. 179000, U.S.N.M.)

63. *Maniple of black silk brocade.*—With borders and crosses in silver lace.—Italy. (Cat. No. 179000, U.S.N.M.)

64. *Maniple of black silk brocade.*—With crosses in yellow silk brocade, and yellow silk fringes.—Italy. (Cat. No. 179001, U.S.N.M.)

65. *Maniple of black velvet.*—With borders and crosses of yellow silk bordered with red silk. The four ends of the crosses terminate in fleurs-de-lis.—Italy. (Cat. No. 179001, U.S.N.M.)

66. *Philippine dalmatic.*—Made of purple velvet, with rosettes and other floral designs in gold appliqué, in form of a wide, loose robe with an opening at the top for passing of the head. The usual form of the dalmatic resembles that of the chasuble, only it is not rounded at the extremities but straight.—Philippine Islands. (Plate 68, Cat. No. 213406, U.S.N.M.)

67. *Bishop's miter.*—Made of white silk, embroidered in gold and set with stones. Dimensions, 16½ by 13¼ inches.—Italy. (Plate 69, fig. 1, Cat. No. 179032, U.S.N.M.)

68. *Bishop's crozier.*—Made of white metal. The crozier is the pastoral staff of the bishop, symbolizing his authority and jurisdiction. It is of metal, hollow, usually highly ornamented, with a hook or curve on the upper end. An archbishop's staff is surmounted by a cross or crucifix; that of a patriarch bears a cross with two transverse bars; and that of the pope bears a cross with three transverse bars. Height, 6 feet 3 inches.—Italy. (Plate 69, fig. 2, Cat. No. 179031, U.S.N.M.)

69. *Pectoral cross.*—Made of silver, gilded. Height, 9 inches.—Italy. (Plate 69, fig. 3, Cat. No. 179033, U.S.N.M.)

70. *Mozzetta* (from Italian *mozzo,* Latin, *mutilus,* mutilated, curtailed).—A short, cape-shaped vestment of scarlet silk, open in front, which can, however, be buttoned over the breast, covering the shoulder, with a little hood behind. It is worn by the Pope, cardinals, bishops, abbots, and others who do so by custom or papal privilege.—Italy. (Cat. No. 211699, U.S.N.M.)

71. *Altar bell.*—Made of brass. At various parts of the mass, especially during consecration and elevation of the host and chalice, a small bell is rung to attract the attention and excite the devotion of those present. Height, 5½ inches; diameter, 2¼ inches.—Spain (Cat. No. 178862, U.S.N.M.)

72. *Silver bell.*—Adorned with three Greek crosses within ovals in chased work. Height, 1⅞ inches; diameter, 1½ inches.—Seville, Spain. (Cat. No. 167045, U.S.N.M.)

73. *Wooden clapper.*—During holy week, when music and joyous sounds are excluded from the church, a wooden clapper or rattle is used in place of a metal bell, to give the various signals to the congregation. Measurements, 12 by 14 inches.—(Cat. No. 179054, U.S.N.M.)

74. *Osculatory.*—A bronze plaque made in form of a facade of the Italian Renaissance style, with the representation of the *Ecce Homo* (Christ holding a scepter—compare Matthew xxvii, 29), and the word Ierosolyma (Jerusalem); in the gable, a cherub, and below, a floral design; with a handle on the back. The osculatory is an instrument whereby the "kiss of peace" is given at a certain stage of the celebration of the mass. Hence its name, from the Latin *osculum*, kiss; it is also called *pax*, peace. In the primitive church the usage was for the "holy kiss" to be given by the members of the congregation promiscuously to one another. In the twelfth or thirteenth century, for reasons of convenience, a substitute for the actual kiss was introduced in the shape of a tablet, bearing the image of Christ, or Mary, or of a saint, or of the crucifixion, and fitted with a handle, which after being kissed by the celebrating priest, was passed to those who were to receive the kiss of peace. It is rarely used at present. Height, 5½ inches; width, 3¼ inches.—Italy. (Plate 70, fig. 1, Cat. No. 179045, U.S.N.M.)

75. *Osculatory.*—Gilt bronze plaque in form of a facade of the Italian renaissance style, flanked by caryatids with a handle behind. In the gable, God the Father giving the blessing; in the center, the descent of the cross, with the Mater Dolorosa above it; below, a cherub. Height, 6¼ inches; width, 4⅜ inches.—Italy. (Plate 70, fig. 2, Cat. No. 179046, U.S.N.M.)

76. *Hourglass.*—An hourglass was formerly kept on the pulpit to regulate the duration of the sermon. Height, 6½ inches; diameter, 3¼ inches.—Italy. (Cat. No. 152250, U.S.N.M.)

77–78. *Vase and tray.*—Made of white metal. Chased and repoussé work. Used for ablution by the bishop before and after celebration of mass. Height of vase, 8 inches; diameters 3 and 2½ inches; diameters of the tray, 12½ and 9½ inches.—Italy. (Plate 65, figs. 2 and 3, Cat. No. 152228, U.S.N.M.)

SERVICE OF BENEDICTION.

The service of Benediction, or as it is more fully called, Benediction of the Blessed Sacrament, is an afternoon or evening devotion. Its main feature is the exposing of the Eucharist (the consecrated host) upon the altar in an ostensory, which is surrounded with lights, incensed and adored. After the singing of certain hymns and litanies the celebrant, clad in a cope and his shoulders enveloped in a humeral veil, in which he wraps his hands, takes the ostensory and makes with it the sign of the cross in silence over the kneeling congregation.

79–80. *Cope, veil, and stole.*—The cope is of yellow croisson silk, the veil of white and blue silk. The cope is a wide garment, reaching nearly to the feet, open in front and fastened by a clasp, with a semicircular cape at the back.—Italy. (Plate 71, Cat. No. 152226, and 179008–9, U.S.N.M.)

81. *Ostensory* (from Latin *ostendere*, to show, to expose, also called monstrance, from Latin *monstrare*, to show).—This consists of a disk encompassed with sunbeams and surmounted by a cross, set upon a long stem, which rests on a base like a chalice. In the center is inserted a lunette, a circular crystal case in which the host is placed for exposition. The base and stem are of brass; the upper part is of silver, gilded. Height, 20¾ inches; diameter, 10 and 4¾ inches.—Italy. (Plate 64, fig. 2, Cat. No. 179018, U.S.N.M.)

82. *Piece of carved ivory.*—Cut in form resembling a heart. In open work are the letters J H S (Jesus hominum Salvator), surmounted by a cross. Above are perforations arranged to represent a crown. Around the edge are incised diagonal or zigzag lines. Perhaps used as an ecclesiastical badge. Dimensions, 4⅝ by 4½ inches.—Italy. (Cat. No. 292307, U.S.N.M.)

83. *Triptych.*—Made in Gothic style, of wood, painted and gilded. On the upper tire is represented Christ seated in the center, the right hand raised in blessing, the left holding the Gospels, with angels' heads at his feet, and Mary and the angel of annunciation on the sides. On the lower tire, in the center, is represented Mary holding the Infant Jesus, attended by angels on either hand; while the two side panels are occupied by St. Peter with the keys and St. Paul with the sword, respectively, each holding the Gospel book. Height, 29 inches; width, 20¾ inches.—Italy. (Plate 72, Cat. No. 179038, U.S.N.M.)

84. *Triptych.*—Made of wood, carved, painted, and gilded. Representing, in relief, the crucifixion. The shrine was used by missionaries on their journeys. Height, 17 inches; width, 27½ inches.—Madrid, Spain. (Plate 73, Cat. No. 178761, U.S.N.M.)

85. *Holy water fountain.*—Made of white metal embossed with a monogram and a crown. A vessel containing water mixed with salt and blessed by a priest is placed at the entrance of churches and houses. Catholics, on entering a church or a house, usually dip the fingers into the vessel and make the sign of the cross. Height, 11 inches; width, 5¾ inches.—Italy. (Plate 74, fig. 1, Cat. No. 152237, U.S.N.M.)

86. *Holy water fountain.*—Made of porcelain. In the center is painted a cross and I H S (*Jesus hominum Salvator*—Jesus Saviour of Mankind). Height, 16¼ inches; width, 7½ inches.—Italy. (Plate 74, fig. 2, Cat. No. 152239, U.S.N.M.)

87. *Holy water fountain.*—Made of white metal. Embossed with the figure of Mary. Height, 9¾ inches; width, 7 inches.—Italy. (Plate 65, fig. 3, Cat. No. 152238, U.S.N.M.)

88. *Holy water fountain.*—Made of brass. The upper part is carved to represent the crucifixion. Height, 7½ inches; width, 3½ inches.—Italy. (Cat. No. 152236, U.S.N.M.)

89. *Holy water fountain.*—Made of brass. Height, 19 inches; width, 12½ inches.—Italy. (Cat. No. 179027, U.S.N.M.)

90. *Holy water fountain.*—Made of porcelain. Height, 9 inches; width, 5 inches.—Italy. (Cat. No. 152240, U.S.N.M.)

91. *Holy water fountain.*—Made of porcelain. Height, 10½ inches; width, 7½ inches.—Italy. (Cat. No. 152241, U.S.N.M.)

92. *Almsbox.*—Rectangular iron box with a slit on top. Dimensions, 5¾ by 4¾ by 1¾ inches.—Italy. (Cat. No. 179040, U.S.N.M.)

93. *Brass basin.*—Adorned with a figure, which is seemingly a combination of rosette and a star, in repoussé work. Probably used for receiving offerings. Diameter, 17⅛ inches.—Italy. (Cat. No. 179028, U.S.N.M.)

94. *Brass basin.*—With an inscription in Gothic (?) characters and a wheel-shaped figure in repoussé and chased work. Diameter, 16¼ inches.—Italy. (Cat. No. 179029, U.S.N.M.)

LITURGICAL WORKS.

95. *Missal (missale) on wooden stand.*—Contains all the liturgy required for the celebration of the mass throughout the year. It is printed in Latin in red and black letters. The black letters constitute the text of the missal, and the red its rubrics or directions in performing the various actions of the mass. Height, 12 inches; width, 8½ inches.—Italy. (Plate 75, Cat. No. 179011, U.S.N.M.)

96. *Altar cards.*—Printed on cardboard and set in carved, gilded frames. Three cards, which contain certain portions of the mass liturgy, for the reading of which it is not convenient to look into the missal, are placed on the altar in an upright position, for the greater convenience of the priest. Height, 16½ and 12 inches; width, 17½ and 10½ inches.—Italy. (Plate 76, Cat. No. 179014, U.S.N.M.)

97. *Manuscript of two parchment leaves of a missal.*—With illuminated initials. Dimensions, 20 by 14 inches.—Italy. (Cat. No. 179012, U.S.N.M.)

98. *Canon of the mass (Canon Missae).*—Containing that part of e mass which is permanent and unchanging in its prayers and remonies, hence the name, "canon"—that is, rule, or fixed stand-

ard. Printed in red and black characters at Venice in 1624. The title-page is adorned with vignettes depicting the Acts of the Apostles, while two full-page illustrations represent the Last Supper of Christ with the Apostles, and the Trinity, and celebration of the Eucharist, respectively. Bound in red Russian leather, gold-tooled with the archepiscopal arms of Venice. Height, 14½ inches; width, 10 inches.—Venice, Italy. (Cat. No. 214725, U.S.N.M.)

99. *Antiphonany* (*Antiphonarium abbreviatum: videlicet dominicale et festivum*).—Contains hymns and psalms which are chanted alternately by two choirs. Printed in Latin in red and black letters at Venice in 1547. Bound in sheepskin. Height, 14 inches; width, 9¾ inches.—Venice, Italy. (Cat. No. 288986, U.S.N.M.) Gift of Miss Louise Salter Codwise.

100. *Pontificale Romanum*.—With wooden stand. The pontifical contains the ritual for the performance of rites and functions reserved for a bishop, such as the consecration of churches, altars, and sacred vessels; the administration of the sacraments of confirmation and ordination, as fixed by Pope Clement VIII (1592–1605). Printed in Latin in red and black characters at Antwerp, Belgium, in 1707. Bound in leather and covered with red velvet. With gilt and tooled edges. Height, 6¾ inches; width, 4 inches.—Atrato River, Colombia, South America. (Cat. No. 286447, U.S.N.M.) Lent by Col. David duBose Gaillard.

OBJECTS OF VENERATION AND DEVOTION.

CROSSES AND CRUCIFIXES.

The cross essentially consists of an upright and a transverse piece placed upon one another in various forms; a crucifix is a cross with a figure fixed on it. The cross was a common instrument of capital punishment among the ancients. It was also and is still a most common religious symbol of pre-Christian and non-Christian religions, and, like the triangle and other geometric figures, it is sometimes merely ornamental in origin with no symbolic significance. In Christianity, on account of the death of Christ upon the cross, it became the principal symbol of faith and emblem of salvation.

There are four principal types of the cross: 1. The Tau cross (*crux commissa*), from its form of the Greek Tau T, also called St. Anthony's cross, after the legend that St. Anthony (about 251–356) exterminated the idols of Egypt with such a cross; it is the earliest form of the cross. 2. The equilateral or Greek cross, where two equal arms cross one another at right angles in the middle. 3. St. Andrew's cross (*crux decussata*), when two shafts of equal length are crossed diagonally in the middle ×, so-called, because the Apostle St. Andrew is supposed to have been martyred upon such a cross; 4. The Latin cross (*crux immissa*, or *capitata*), in which the upright is longer than the transverse beam and is crossed by it near the top †. It is the form supposed to have been used in the crucifixion of Christ. A variety of this cross is the Lorraine or Jerusalem cross, with two transverse bars, the upper one shorter than the lower ‡, so-called, because Godfrey de Bouillon, Duke of Lorraine, when chosen by the Crusaders as the first king of Jerusalem (1099), adopted this cross. It is also called the cardinal cross, because it is one of the distinctive insignia of cardinals and archbishops.

101. *Processional cross.*—Made of bronze. With trefoil ends (cross *botone*). From the four angles of the junction of the two beams issue rays. Above is a tablet with the title: J N R J, the initials of *Jesus Nazarenus Rex Judaeorum* (Jesus of Nazareth, King of the Jews), the inscription Pilate is recorded to have placed upon the cross of Christ (John xix, 19–20). With a socket for inserting a pole. Church processions are always headed by a cross fastened on a pole. Height, 33 inches.—From a church of San Domingo, Valley of Mexico. (Plate 77, Cat. No. 158316, U.S.N.M.)

102. *Processional* (?) *cross.*—Made of bronze, richly adorned in chased and hammered work. At the ends are medallions representing, respectively: On top, God the Father holding in the left hand a cross and with the right giving the blessing; to the right, Mary; to the left, probably John the Baptist; and below, John the Evangelist, holding the cup of the Eucharist. The figure of Christ was broken away. With a tang for inserting into a shaft. Height 12 inches.—Italy. (Plate 78, Cat. No. 152231, U.S.N.M.)

103. *Ivory cross with appurtenances of the Passion.*—The cross proper rises from a post which is set into a base. Both the post and the base have on their sides a sort of railing in open work. The base rests upon a plinth and this again is placed on a platform. At the corners of the base are twisted columns and on top of the corners of the base as well as of the plinth and platform are carved vases. The front and back are adorned with rosettes and clusters of grapes. The whole stands on rounded feet.

The objects connected with the Passion represented on this cross are, beginning at the top, a pelican. From the habit of this bird of storing food in the large pouch attached to its lower mandible for the purpose of feeding its young, which it does by pressing the pouch against the breast, arose the belief that it opened its breast with its bill to feed its young with its own blood—a belief which seemed to derive support from the red at the end of the bill, and thus the pelican became a symbol of Christ's love for his church.

Underneath is the tablet inscribed with the title, *I N R I—Jesus Nazarenus Rex Judaeorum* (Jesus of Nazareth, King of the Jews—John xix, 19–20). Upon the transverse beam are, at the right end (of the plate) a winged sphinx, at the left a winged, horned griffin.

To the right of the vertical beam a hand, and to its left a vase. These, with the bundle or tuft fastened to a staff seen next to the sphinx, may either refer to the episode of the alabaster vase with precious ointment which Mary of Bethany poured upon the feet of Jesus and dried them with her hair, shortly before the Passion (John xii, 3), or to that of the washing of the feet of the disciples by Jesus (John xiii, 4–5), while next to the griffin is the lance with which Jesus' side was pierced (Matthew xxvii, 49). On the front of the transverse beam is in the center the crown of thorns (Matthew xxvii, 28), and to its sides the hammer and tongs, respectively, and a nail at either side of them. Beneath the transverse beam are, in succession, the seamless coat of Jesus and the dice which the soldiers used in casting lots for it (John xix, 23–24); two swords (Luke xxii, 38 and 50); the lantern which the officials used in their search for Jesus (John xviii, 3); and the handkerchief, or *sudarium* of Veronica. This refers to the story that when Jesus passed her door, bearing his cross, Veronica, touched with compassion, wiped the drops of agony from his face, and the features of Jesus were imprinted upon the cloth. According to another account Veronica was the woman that was healed by touching Christ's robe (Matthew ix, 20–21). Desiring a portrait of him, St. Luke thrice painted it. Then Jesus said to her, "Unless I aid you, Luke's art is in vain, for my face is only known to him who sent me." Afterwards, being at her house, he asked for water to wash his face, and returned to her the napkin with the portrait. Five cities claim the possession of the genuine sudarium of Veronica—Turin in Italy, Toulouse, Besançon, and Campiegne in France, and Sorlat in Spain (?). Veronica herself is honored by a shrine at the right hand of the high altar of St. Peter's in Rome, and her festival is observed on the 4th of February.

Farther down, a cherub; skull and crossbones, emblematic of Christ's triumph over death and the grave, or it may be intended to indicate Golgotha, the place of skulls (Matthew xxvii, 33). It is also explained as the skull of Adam, according to the tradition that the cross was placed on the resting place of the first father of mankind. Upon a sort of platform underneath is placed the cock of St. Peter (Matthew xxvi, 34 and 74). From the platform rise on staffs to the right the cup of vinegar and to the left the sponge which was dipped into it and reached up to Jesus on the cross (Matthew xxvii, 48). Diagonally placed are the ladder for mounting up to the cross, and the pillar, with the rope wound around it, with which Jesus was bound to the pillar to be scourged (Matthew xxvii, 26). Lastly, the vase and basin which rest on the base may either be intended for the vessels which Jesus used in washing the feet of the disciples (John xiii, 4–5), or for those in which the spices were brought to the grave to anoint the body of Jesus (John xix, 39; Comp. Mark xvi, 1).

Height, 18¼ inches.—From the old Mission Church at Jemez, New Mexico. (Plate 79, Cat. No. 211877, U.S.N.M.)

104. *Wooden cross.*—Inlaid with straw to represent the instruments of the Passion. Height, 21 inches.—From an old Spanish church in Cabolca, Senora, New Mexico. (Cat. No. 179041, U.S.N.M.)

105. *Wooden cross.*—Inlaid with straw in a lozenge pattern. Height, 21 inches.—From an old Spanish church in Cabolca, Senora, New Mexico. (Cat. No. 179042, U.S.N.M.)

106. *Wooden crucifix.*—With the figure of Christ in mother-of-pearl. Height, 3¾ inches.—Palestine. (Cat. No. 74617, U.S.N.M.)

107. *Lorraine crucifix.*—Made of silver, openwork. Pendant. Height, 3½ inches.—Nurnberg, Germany.—(Cat. No. 286813, (U.S.N.M.) Lent by Miss Julia Halsted Chadwick.

108. *Glass cross.*—Consisting of cut crystals fixed to a frame of brass rods. Pendant. Height, 3½ inches.—Probably from Italy. (Cat. No. 262158, U.S.N.M.) Lent by Mrs. G. Brown Goode.

109. *Wooden crucifix.*—Inlaid with pieces of looking-glass. The figure is of white metal and fastened to a chased metal plate. The four ends are likewise encased in metal, terminating in trefoils (cross *botone*). Pendant. Height, 5½ inches.—Spain. (Cat. No. 286814, U.S.N.M.) Lent by Miss Julia Halsted Chadwick.

110. *Wooden crucifix.*—With the figure of Christ of brass. Over the crossbeam is the title, *I N R I* (Jesus of Nazareth, King of the Jews). At the four ends are medallions, representing, at the top, a dove, symbol of the Holy Ghost (Matthew iii, 16); to the right, the bust of Christ; to the left, the bust of Mary; and below a lamb, symbol of Christ (John 1, 29). Height, 4½ inches.—Mexico. (Cat. No. 277743, U.S.N.M.). Lent by Major Harry S. Bryan.

111. *Pectoral cross.*—Made of brass, gilded. Hollow and chased work. Height, 4 inches.—Italy. (Cat. No. 179117, U.S.N.M.)

112. *Lorraine cross.*—Made of brass, hammered work. Engraved on one side, "San Antoni ora pro me" (St. Anthony, pray for me); on the other, "San Cornelia ora pro me" (St. Cornelia, pray for me) Height, 3¼ inches.—Italy. (Cat. No. 179118, U.S.N.M.)

RELICS AND RELIQUARIES.

Relics are the remains of departed saints. They include (1) the bodies or parts of the bodies of the venerated persons; (2) objects used by them or connected with their death, such as clothes, vestments, rosaries, the nails, lance, spear, or fragments of the true cross of Christ, the girdle, veil of Mary, etc.; and (3) objects connected with their tomb or hallowed by contact with their bodies. Relics are often carried in solemn procession, and pilgrimages are made to the churches or monasteries in which they are preserved. No church building can be consecrated unless it contains relics. Reliquaries are repositories of relics and are usually made of precious metals and adorned with jewels, in form of a box, casket, or shrine. The veneration of relics dates back to the early centuries of Christianity; in the fourth century it was already widely spread.

113. *Silver reliquary.*—Made in form of an ostensory, encompassed by sunbeams. Chased work. Behind the glass is seen a crosslet, supposed to be made from a particle of the true cross. By the "true cross" is meant the actual original cross upon which Jesus was crucified. It is believed by both the Roman Catholic and the Eastern Church that the cross buried upon Golgotha was found in 326 A. D. by the Empress Helena, mother of Constantine the Great, and the church commemorates this event by appointing the 3d of May (in the Eastern Church the 13th of September) as the annual festival of the discovery of the cross (*inventi crucis*). Height, 8½ inches.—Seville, Spain. (Cat. No. 166987, U.S.N.M.)

114. *Reliquary.*—Consisting of an oval metal frame. Behind the glass in front is a tiny cross set in a gilt frame of scroll design. An inscription reads, *Lignum S S. crucis D. N. J. C.* (wood of the most holy cross of our Lord Jesus Christ). On the back is the episcopal wax seal, attesting to the genuineness of the relic. Diameters, 1¼ by 1⅛ inches.—Probably from Italy. (Cat. No. 256893, U.S.N.M.) Lent by Mrs. S. Brown Goode.

115. *Relic of St. Anne, mother of Mary.*—In an oval case of white metal. On the back is in relief an effigy of Mary and the petition in French, "O Mary, conceived without sin, pray for us who take their refuge to thee." Diameters, 1 inch by ⅞ of an inch.—Italy. (Cat. No. 179058, U.S.N.M.)

116. *Relic of St. Peter.*—In an oval case of white metal, with the episcopal seal. Diameters, 1½ by 1¼ inches.—Italy. (Cat. No. 179061, U. S. N. M.)

117. *Relics of St. Clement.*—Consisting of two molar teeth in a brass frame. St. Clement was the third bishop of Rome toward the end of the first century. Diameters, 1⅞ by 1½ inches.—Italy. (Cat. No. 179060, U.S.N.M.)

118. *Relics of Christ, Mary, St. Joseph, St. Francis a Paula (1416–1507), St. Francis Xavier, 32 (1506–1552), St. Theresa (1515–1582), and St. Aloysius Gonzaga (1568–1591).*—In an oval brass case. Diameters, 3 by 2½ inches.—Italy. (Cat. No. 179062, U.S.N.M.)

119. *Relic of St. Charles Borromeo (1538–1584).*—In an oval case of white metal with the episcopal seal. St. Borromeo was Cardinal and Archbishop of Milan. Diameters, 1¼ by 1 inch.—Italy. (Cat. No. 179059, U.S.N.M.)

120. *Silver reliquary.*—Oval containing relics of Mary, St. Joseph, St. John of the Cross (1542–1591), and St. Theresa, framed by a floral design in filagree work, studded with colored stones. With the epis-

copal seal. Height, 3 inches; width, 2¼ inches.—Italy. (Cat. No. 179037, U.S.N.M.)

121. *Silver reliquary.*—With miniature painting of Mary. Spanish workmanship. Brought to New Mexico in 1783 by Padre Sanchez. Diameters, 4 and 3 inches.—Pueblo of Tesuque, New Mexico. (Cat. No. 176080, U.S.N.M.)

122. *Silver reliquary.*—With miniature paintings. Height, 2¼ inches; width, 2 inches.—Madrid, Spain. (Cat. No. 178864, U.S.N.M.)

123. *Sacred heart.*—Model of a burning heart, made of brass. The adoration of and devotion to the sacred heart of Jesus, as a noble part of his person and a symbol of his love, became general and popular in the Catholic Church through Margaret Marie Alacoque, a French nun of the Visitation Order, who lived in the seventeenth century. Since 1856 a yearly feast in honor of the sacred heart is celebrated on Friday after the feast of Corpus Christi. Height, 2½ inches.—Italy. (Cat. No. 179063, U.S.N.M.)

IMAGES.

The cult of images is practiced both in the Roman Catholic and in the Eastern Church. In the Roman Catholic Church both pictures and statues are used, while the Eastern Church forbids statues. The doctrine of the Roman Catholic Church concerning the veneration of images, as formulated by the Council of Trent (1563), is that the images of Christ, of the Virgin Mother of God, and of the saints are to be had and retained particularly in temples, and that honor and veneration are to be given them; not that any divinity or virtue is believed to be in them on account of which they are to be worshiped, or anything is to be asked of them, but because the honor which is shown to them is referred to the prototypes which those images represent; in such wise that by the images which we kiss, and before which we uncover the head and kneel, we adore Christ and venerate the saints whose likenesses they bear. The cult paid to images is designated with the Greek word *dulia* (secondary veneration), in contradistincton from *latria* (supreme worship), which is allowed to be offered to God only.

124. *Jesus in Gethsemane.*—Representing Jesus kneeling with the cup in front of him (Matthew xxvi, 36). Carved in relief upon a piece of limestone from the river Jordan.—Jerusalem, Palestine. (Cat. No. 76975, U.S.N.M.)

125. *Wooden figure of Christ.*—The long curled locks are held by the crown of thorns of gilded brass; behind the head rises a cruciform halo of the same material; around the loins is a kind of apron, like-
of gilded brass, with birds and floral designs in respoussé work,
under it is a loin cloth of blue satin. In the hands and feet,
latter are crossed over one another, are the holes of the nails,

and on the left side of the chest is the hole caused by the spear (John xix, 34). The figure evidently was part of a crucifix. Height, 12 inches.—Philippine Islands. (Plate 80, Cat. No. 213405, U.S.N.M.)

126. *Wooden figure of Christ.*—Similar to the preceding one. The loin cloth consists of a piece of brocade, with gold appliqué. Height, 28 inches.—Philippine Islands. (Cat. No. 213405, U.S.N.M.)

127. *Cloak of figure.*—Made of red satin, with the letters *J H S* (*Jesus hominum Salvator*—Jesus Saviour of Mankind) and fleurs-de-lis in gold appliqué.—Philippine Islands. (Cat. No. 213–408, U.S.N.M.)

128. *The Lord's Supper.*—Engraved on the shell of the pearl oyster. Measurements, 6 by 6 inches.—Bethlehem, Palestine. (Plate 81, fig. 1, Cat. No. 74542, U.S.N.M.)

129. *The Ascension.*—Engraved on the shell of the pearl oyster. Around the center representing the Ascension are 12 medallions, representing the apostles with their emblems, in the following order: 1, St. Peter with the keys; 2, St. Paul with the sword; 3, St. Matthew with the pick; 4, St. James the Lesser with the club; 5, St. John with the chalice; 6, St. James the Elder with the pilgrim's staff; 7, St. Philip with the small cross; 8, St. Bartholomew with the book and knife; 9, St. Andrew with his cross (the *crux decussata*, see above p. 617); 10, St. Thomas with the architect's square; 11, St. Matthias with the ax; 12, St. Simon with the saw. Measurements, 6 by 6 inches.—Bethlehem, Palestine. (Plate 81, fig. 2, Cat. No. 74541, U.S.N.M.)

130. *Bust of Mary.*—Made of terra cotta, painted and gilded. Mary, the mother of Christ, is venerated in the Catholic Church as the most exalted of created beings. She is called the "Blessed Virgin," the "Holy Virgin," "Our Lady" (Italian "Madonna"), and since the Council of Ephesus in 431 the designation "Mother of God" is formally applied to her. While the veneration paid to other saints is termed *dulia,* she alone is entitled to *hyperdulia,* and her intercession is invoked more than that of all others. She is the patroness of many countries, cities, and societies. In ecclesiastical art she occupies a most important position, and all the chief events of her life have formed the subjects of artistic representation. Height, 12 inches.—Italy. (Cat. No. 179049, U.S.N.M.)

131. "*Virgin of the Pillar.*"—Statuette made of brass, chiseled work, representing Mary standing upon a pillar, holding in her left arm the Infant Jesus, both crowned, with a halo of rays and stars. This is a model of a celebrated statue of that name (Nuestra Senora del Pilar) at Saragossa in Spain. Tradition asserts that the Virgin, standing upon a pillar, appeared to St. James (San Jago), the apostle and patron saint of Spain, when he was making a missionary pilgrimage through Spain. Height, 7 inches.—Spain. (Cat. No. 178866 U.S.S.N.M.)

132. "*Virgin of the Pillar.*"—Miniature statuette of silver, gilded. Height, 2⅞ inches.—Spain. (Cat. No. 178865, U.S.N.M.)

133. *Statuette of Mary.*—Called "Virgin of Good Friday." Made of brass, chiseled work. Height, 4½ inches.—Madrid, Spain. (Cat. No. 178867, U.S.N.M.)

134. *Bust of Mary.*—Made of papier-mâché, with a dome-shaped crown. Height, 10 inches.—Italy. (Cat. No. 179052, U.S.N.M.)

135. "*Pieta.*"—Mary holding the body of Christ. Statuette of wood, painted. Height, 13 inches.—Italy. (Cat. No. 179048, U.S.N.M.)

136. "*Pieta.*"—The same as the preceding one. Height, 12 inches.—Italy. (Cat. No. 179048a, U.S.N.M.)

137. *Crown.*—Made of bronze, gilded, and adorned with colored stones. Dates from the seventeenth century. It decorated an image of Mary, in the demolished church of St. Anna, the former nunnery, Zbraslovski Dom, in Prague, Bohemia. Height, 5 inches; diameter, 4 inches.—Prague, Bohemia. (Cat. No. 154776, U.S.N.M.)

138. *Porcelain plaque.*—Representing Mary, in relief. Dated 1795. Height, 13 inches; width, 9¾ inches.—Florence, Italy. (Cat. No. 214721, U.S.N.M.)

139. *Porcelain plaque.*—Painted with three figures—Mary, crowned, and two women performing the devotion of the rosary before her. Dated from the seventeenth century. Height, 9¾ inches; width, 10½ inches.—Italy. (Cat. No. 152242, U.S.N.M.)

140. *Silver medallion.*—Representing, on one side, Mary with the Infant Jesus; on the other, a burning heart pierced by a sword, alluding to Luke ii, 35. Set in silver filigree. Measurements, 1¾ by 1½ inches.—Italy. (Cat. No. 179056, U.S.N.M.)

141. *Miniature of Mary.*—Painted on glass. Diameters, 2 and 1⅓ inches.—Spain. (Cat. No. 178869, U.S.N.M.)

142. *Two processional banners.*—Made of white metal. Embossed on one side with the figure of Mary, holding in the right hand a rosary, on the left arm the Infant Jesus; on the other side, with the figure of St. Dominic, to whom the introduction of the rosary in its present form is ascribed, holding a lily, which is his emblem. Probably used at the feast of the rosary, which is celebrated on the first Sunday in October. Measurements, 10 by 7 inches.—Italy. (Plate 82, Cat. No. 179070–071, U.S.N.M.)

143. *Silver medallion.*—Representing, on one side, St. Peter; on the other, St. Paul. Set in silver filigree. Diameter, 1½ inches.—Italy. (Cat. No. 179057, U.S.N.M.)

144. *Mace of St. Sebastian.*—Made of white metal, terminating at the top in a statuette of the saint. St. Sebastian was, according to tradition, a Roman soldier and Christian martyr, having been shot to death about 288 A. D., by order of Diocletian. He is vener-

ated in the Catholic Church as patron of sharpshooters and protector from pestilence. He is usually represented as a fair youth bound to a pillar or tree and riddled with arrows. The mace was probably carried in procession on his festival, on the 20th of January. Length, 2 feet 1 inch.—Italy. (Cat. No. 179068, U.S.N.M.)

145. *Porcelain plaque representing St. Anthony of Padua.*—St. Anthony, born in Lisbon, Portugal, in 1195; died near Padua, Italy, in 1231; was a Franciscan theologian and preacher to whom the performance of many miracles are attributed. He was canonized by Gregory IX in 1232, and his day in the Roman calendar is June 13. He is especially invoked for the recovery of things lost. Diameters, 14 by 8½ inches.—Italy. (Cat. No. 179035, U.S.N.M.)

146. *Porcelain plaque of the Sodality of St. Anthony of Padua.*—Dated 1620. A sodality is a congregation or association consisting of lay persons, meeting together at stated times, under ecclesiastical direction for the performance of pious exercises. Diameters, 14 by 12 inches.—Italy. (Cat. No. 179036, U.S.N.M.)

147. *St. Theresa.*—Statuette of wood. St. Thereas (born 1515, died 1582) was a Spanish nun of the Carmelite Order, of which she founded a reformed branch. She is famous as a writer of mystical and ascetical works. She was canonized in 1622, and is also venerated, next to St. James, as patron saint of Spain. Height, 21 inches.—Italy. (Cat. No. 179-047, U.S.N.M.)

148. *St. Theresa.*—Souvenir of the tercentenary anniversary of her death in 1582. Plaque of white metal bearing her image. Height 4½ inches; width, 2¼ inches.—Madrid, Spain. (Cat. No. 167043, U.S.N.M.)

PRINTS.

They are for the greater part representations of images or paintings which are preserved and venerated in some church, mostly in Siena, Italy.

149. *Christ on the cross.*—Print on paper. To the right stands Adam in the attitude of adoration; to the left, a winged figure in Corinthian helmet, holding in the right hand a lance and with the left pointing to the crucified; below lies Eve in sleep. A serpent is biting the feet of Christ, in allusion to Genesis iii, 15. 8½ by 6¾ inches.—Italy. (Cat. No. 179079, U.S.N.M.)

150. *The Holy Child of Cebu* (*Santo Nino de Cebu*).—Print on paper. "The oldest miraculous image is the Holy Child of Cebu, reputed to have been found on the shore of the island of Cebu in 1565. It is said to be an image of the Holy Child Jesus. It is a wooden image 15 inches long, with ebon features, and is kept in a strong room in the church of the Holy Child, on the island of Cebu. When exposed to view before the populace it has the honors of field marshal accorded

to it. During the annual feast held in its honor, January 20, pilgrims from the remotest islands and from across the sea come to purify their souls at the shrine of the Holy Child."[1] 29¼ by 20 inches.—Manila, Philippine Islands. (Cat. No. 205542, U.S.N.M.)

151. *Madonna of the Olive.*—Print on paper. Representing the Madonna with the Infant Jesus, with cherubs fluttering over them. Inscribed above in Latin, "Like a green olive tree in the house of God." (Psalm lii; in the Catholic Bible, li, 8.) Below is stated, in a colophon in Italian, that it is a "representation of the miraculous image of the Most Holy Mary of the Olive which is kept in the Church of Picve Vecchia, which was carried in procession in Siena in 1820 with a relic of the veil of the same Virgin." 11 by 8 inches.—Siena, Italy. (Cat. No. 179080, U.S.N.M.)

152. *Madonna of Intercession.*—Print on paper. Representing the Madonna with the Infant crowned. The colophon in Latin states that the original is preserved in a chapel of the metropolitan church at Siena for the solemn supplication on Low Sunday—that is, Sunday next after Easter (*dominica in albis*, the Sunday of white garments, from the white robes worn in early times by those who had been baptized just before Easter). 14½ by 10¼ inches.—Siena, Italy. (Cat. No. 179081, U.S.N.M.)

153. *Madonna, crowned.*—Print on paper. Surrounded by floating cherubs and worshiped on one side by a monk, on the other by a nun. The colophon states that it is a representation of the image which is venerated in the Church of Insigne Collegiata of Provenzano. It was crowned in 1681 and carried in procession on Low Sunday of 1850 with relics of St. Bernardine, St. Catherine, and others. 14¾ by 10½ inches.—Siena, Italy. (Cat. No. 179082, U.S.N.M.)

154. *Madonna of Good Counsel.*—Print on paper. Representing the Madonna with the Infant crowned, surrounded by cherubs. Below is a mountain scenery with a church or citadel. The original is, as the colophon states, venerated in the Church of St. Leonard in Siena and was carried in procession on Low Sunday of 1833, together with a relic of the veil of Mary and the relics of John the Baptist, St. Jerome, St. Anthony of Padua, and St. Eurosia. 15 by 10 inches.—Siena, Italy. (Cat. No. 179083, U.S.N.M.)

155. *Madonna.*—Print on paper. Representing the Madonna in a columned shrine which is supported by two cherubs and surmounted by a crown, orb, and cross which are held by two cherubs. The whole is surrounded by aureole of rays and framed in a wide arch. Beneath to the right is a female saint holding a lily stalk and a book; to the left, a male saint holding a paten or tray. In the upper corners are deer. It is a representation of the miraculous image of Holy Mary of Insigne Collegiata of Provenzano in Siena. It was crowned No-

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[1] Rev. Curtin G. Roop in the Missionary Review, vol. 15 (September, 1902), p. 685.

vember 1, 1681, and carried with solemn pomp in procession with a relic of the veil of Mary, the pallium of the patriarch St. Joseph, and the relics of Saints Concittadio, Bernardino, Catherine, Ludovico, and Cristina on Low Sunday of 1850. 23 by 18 inches.—Siena, Italy. (Cat. No. 179084, U.S.N.M.)

156. *Madonna of Grace.*—Print on paper. Representing the Madonna with the Infant, both crowned in a frame which is upheld by two angels, while over it are floating three cherubs,and the whole is inclosed in a wide arch. The inscription states that the original is venerated in the chapel of Pope Alexander VII in the Sanesi Metropolitana, and was carried in solemn procession on Low Sunday of 1860. 21 by 14¾ inches.—Siena, Italy. (Cat. No. 179085, U.S.N.M.)

157. *Madonna.*—Print on paper. Representing the Madonna with Infant and a female saint on either side. The original is venerated in the Church of the Servites (Servi Beatae Mariae Virginis, founded in 1240) at Siena and was carried in procession on Low Sunday of 1817. 11¾ by 8¼ inches.—Siena, Italy. (Cat. No. 179086, U.S.N.M.)

158. *Madonna of the Rosary.*—Print on parchment. Representing the Madonna with the Infant crowned, holding a rosary and cross, respectively, and surrounded with 15 cameos depicting the 15 mysteries of the rosary (for which see below, p. 630). 3¾ by 2¾ inches.—Italy. (Cat. No. 179087, U.S.N.M.)

159. *Madonna of the Rosary.*—Print on paper. Representing the Madonna with the Infant crowned, both holding rosaries, the Infant also holding in the right hand the terrestial orb surmounted by a cross (symbolizing the subjection of the world to the cross). In the corners are cherubs. The original is venerated in the Church della Contrada della Chiocciola and was carried in procession on Low Sunday of 1870. 15½ by 11 inches.—Italy. (Cat. No. 179090, U.S.N.M.)

160. *Madonna of Devotion.*—Print on paper. Representing the Madonna with the Infant crowned within a portal of the renaissance style. In the gable are a dove (symbol of the Holy Ghost) and four cherubs in clouds from which rays issue, and surmounted by a crown and cross which are supported by two cherubs. On the sides are cherubs holding lighted candelabra. The original is venerated by the Venerable Society of Maria de Portico della di Fontegiusta and was carried in procession, together with relics, on Low Sunday of 1818. 11½ by 8½ inches.—Italy. (Cat. No. 179088, U.S.N.M.)

161. *Madonna with the Sword in Her Bosom.*—Print on silk. In allusion to Luke ii, 35. 7¾ by 6¾ inches.—Italy. (Cat. No. 179089, U.S.N.M.)

162. *Madonna of the Immaculate Conception.*—Print on paper. Representing the Madonna crowned with a halo of stars and a scepter in her right hand, standing in an arch within a portal of the renaissance style. In the gable are a dove and three cherubs in a circle

rays and surmounted by a crown which is held by two floating cherubs. The original is venerated in the parochial Church of St. Mamiliano in the Valli suburb of Siena, and was carried in procession on Low Sunday of 1849 together with relics. 17¼ by 12¼ inches.—Siena, Italy. (Cat. No. 179091, U.S.N.M.)

163. *Satin print.*—Containing, in Italian, a sonnet, commemorating the annual festival of John the Baptist, celebrated by a society named after him. 22 by 19½ inches.—Siena, Italy. (Cat. No. 152247, U.S.N.M.)

164. *St. Dominic.*—Print on silk St. Dominic, born at Carthagena, Spain, in 1170, died at Bologna, Italy, in 1221, was the founder of the order of the Dominicans or Preaching Monks in 1216. He is represented with his emblem, the lily stalk. 13 by 9½ inches.—Italy. (Cat. No. 152248, U. S. N. M.)

165. *St. Bernardine of Siena.*—Print on paper. St. Bernardine, 1380–1444, was a member of the Minorites of St. Francis, a missionary and reformer. He is often called the "Apostle of Italy," and is one of the most popular saints of Italy, especially of his native city, Siena. 5¾ by 4½ inches.—Siena, Italy. (Cat. No. 179097, U.S.N.M.)

166. *St. Loyola.*—Print on paper. From a print by Bolswert after a painting by Rubens. St. Ignatius Loyola, born in Loyola, Spain, in 1491, died in Rome, Italy, in 1556, was the founder of the Society of Jesus. 15¼ by 10½ inches.—Italy. (Cat. No. 179096, U. S. N. M.)

167. *Suarez.*—Print on paper. Francisco Suarez, born in Granada, Spain, in 1548; died in Lisbon, Portugal, in 1617, was a noted Jesuit theologian and scholastic philosopher. 12 by 8¼ inches.—Italy. (Cat. No. 179094, U.S.N.M.)

168. *Plessis.*—Colored print on paper. Joseph Octave Plessis, 1763–1822, was bishop of Quebec from 1806 to 1822. 13¼ by 9½ inches. (Cat No. 179095, U.S.N.M.)

169. *Twenty-four plates.*—Depicting the revelations and visions of Joannes de Malta, a native of the Provence, France, founder of the order of the Trinitarians for the redemption of captives (*ordo Sanctae Trinitatis et de redemptione captivorum*) in 1198. Printed in Paris, France, in 1633, bound in vellum. 14⅝ by 10¾ inches. (Cat. No. 28528, U.S.N.M.)

170. *Theological disputation.*—Print on paper. It was held in Siena in November, 1781. 24 by 21 inches.—Siena, Italy. (Cat. No. 179099, U.S.N.M.)

171. *Philosophical disputation.*—Print on paper. It took place at Siena in April, 1790. 36½ by 20½ inches.—Siena, Italy. (Cat. No. No. 179100, U.S.N.M.)

172. *Bronze doors of the cathedral of Pisa.*—Three leaves with one of Italian text giving the history and description. The bas-reliefs of the doors. which depict the lives of Mary and Jesus, were executed

by the Dominican Padre Domenico Partigiani and Angelo Serrano after the designs of Giovanni da Bologna and others about 1602. 23 by 18 inches.—Italy. (Cat. No. 179093, U.S.N.M.)

173. *Wooden die for pictures of the Madonna.*—3¼ by 2⅜ inches.—Italy. (Cat. No. 179064, U.S.N.M.)

174. *Leaden Die for the Picture of Saint Romuald* (about 950–1027) *founder of the Camaldolese order.*—Oval, 2¼ by 1⅞ inches.—Italy. (Cat. No. 179065, U.S.N.M.)

RELIGIOUS MEDALS.

Religious medals have the object to commemorate persons (Christ, Mary, saints, and angels) and historical events (dogmatic definitions, miracles, anniversaries, dedications, etc.). They are issued by various ecclesiastical authorities and by confraternities for badges and decoration of their members. They are worn by the faithful and believed to be, by reason of their having been blessed by a priest, a means of grace and to possess protective virtues.

175. Out of about 350 of such medals in the collection of the United States National Museum, 16 are reproduced on the plate. They represent—1, St. Benedict (480–543), founder of the order of the Benedictines; 2, St. Joseph and the Infant Jesus; 3, the Virgin with the Infant; 4, the Virgin, surrounded by rays; 5, Leo XIII, Pope, 1878–1903; 6, the sacred hearts of the Holy Family (Jesus, Mary, Joseph); 7, head of St. Anastasius, monk and martyr; 8, St. Benedict; 9, St. Louis de Gonzaga (1568–1591), holding a crucifix and a skull; 10, the Trinity; 11, the Holy Family; 12, St. Francis of Assisi (1182–1226), founder of the order of Franciscans; 13, Virgin and the Infant, enthroned; 14, arms of the Capuchins of Milan, Italy, in 1856; 15, St. Joseph with the Infant; 16, the Virgin with the Infant, crowned.—Italy. (Plate 83, Cat. No. 179077, U.S.N.M.)

VOTIVES.

Votive offerings are set up in churches or chapels as a thanksgiving for some signal answer to prayer, resulting in the deliverance from peril or the cure of disease. Usually a likeness of the part of the body healed, in silver or some other material, is put up. The custom was also in vogue among the ancient Greeks and Romans.

176. *Votive offerings.*—Made of silver foil. Consisting of models of two hearts, an arm, a pair of eyes, a pair of breasts, a praying woman, and a child.—Italy. (Cat No. 179069, U.S.N.M.)

177. *Votive offerings.*—Made of hollow wax. Representing a pair of eyes, an arm, and the foot of a horse.—Seville, Spain. (Cat. No. 167064, U.S.N.M.)

178. *Votive offering.*—Made of silver amalgam in form of a tower. Height, 2¾ inches.—Potisi, Bolivia. (Cat. No. 179104, U.S.N.M.)

ROSARIES.

The rosary (from the Middle Latin, *rosarium*, properly a garland of roses) is a string of beads, generally formed into a circlet or loop, used for keeping count of prayers or formulas repeated in religious devotions. The materials of which it is made range from natural berries or common wood to costly metals and precious stones. Such devices to assist the memory in complex repetitions occur also among the Hindus, Buddhists, and Mohammedans. In fact, it can be said that some form or other of rosary is used by about three-fourths of the world's inhabitants. The Roman Catholic rosary in its present form and the method of devotion performed with its aid is ascribed to St. Dominic (1170–1231), the founder of the Dominican order, to whom, according to legend, the Virgin Mary handed a rosary from heaven as a weapon against heretics and infidels. But both the practice of often repeating prayers and the employment of some expedient for recording the number of repetitions can be traced to a much earlier date.[1]

The ordinary Catholic rosary consists of 150 small beads, divided into decades by 15 larger beads. To these beads, forming a chaplet, is usually attached a pendant, consisting of a crucifix, one large and three small beads. The devotion begins with the invocation. "In the name of the Father, the Son, and the Holy Ghost." Then the Apostles' Creed is recited on the crucifix, a paternoster (the Lord's Prayer) on the larger bead, and three Ave Maria (Hail Mary) on the three smaller beads, closing with the Gloria (Glory be to the Father, to the Son, and to the Holy Ghost"). This forms the introduction to the rosary proper. Then follow decades of aves, counted by the smaller beads, each decade preceded by a paternoster, for which a larger bead is used, and followed by a gloria. The 150 aves correspond to the number of Psalms, hence from an early period the devotion was called "Our Lady's Psalter." For each decade a subject, or "mystery," in the life of Christ and Mary is set for meditation, the 15 mysteries being divided into five joyful, five sorrowful, and five glorious. The five joyful mysteries are: The annunciation (Luke i, 26), the visitation (Luke i, 39), the nativity (Luke ii), the presentation (Luke ii, 21), and the finding in the temple (Luke ii, 41). The five sorrowful mysteries are: The agony in Gethsemane (Matthew xxvi, 36), the scourging (Matthew xxvii, 26), the crowning with thorns (Matthew, xxvii, 29), the carrying of the cross (John xix, 17), and the crucifixion (Matthew xxvii, 35). The five glorious mysteries are: The resurrection (Matthew xxviii), the ascension (Luke xxiv, 50), the descent of the Holy Ghost (Acts ii), the assumption of Mary into heaven, and the coronation of Mary in heaven (the two last mysteries are accepted on the authority of tradition). The rosary most in use, however, consists of five decades for the aves and five larger beads for the paters, called the "lesser rosary." Otherwise it is arranged in the same way and recited in the same manner and order as the "greater" or "full" rosary. The entire devotion of 15 decades may be said on it by counting it three times.

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[1] For a fuller discussion of the subject see The collection of rosaries in the United States National Museum, I. M. Casanowicz, Proc. U. S. Nat. Mus., vol. 36, pp. 333–360, with pls. 21–30, Washington, Government ting Office, 1909.

Besides this "Dominican rosary," which is used in common by all Catholics, there are other varieties of chaplets used by particular religious bodies or for special devotions. So the chaplet of St. Bridget of Sweden (about 1303–1373), which consists of 63 beads for the aves, to commemorate the 63 years which Mary is supposed to have lived; the crown of our Lady, in use among the Franciscans, has 72 aves, based on another tradition of Mary's age; and others more.

The Feast of the Rosary is observed on the first Sunday in October as the anniversary of the victory of the Christians over the Turks in the naval battle at Lepanto, near the Echinades Islands, on October 7, 1571, which is attributed to the power of the devotion of the rosary.

Rosaries are usually blessed with prayers and holy water by some duly authorized ecclesiastical person and become thereby sacramentals—that is, instruments of grace.

179. *Rosary of mother-of-pearl.*—The full or greater Dominican rosary. The 15 decades are divided by the insertion in two places of four extra beads, one large and three small ones, into three divisions of five decades each. The chain on which the beads are strung, as also the figure of Christ on the crucifix, are of German silver. Length, 7 feet.—Italy. (?) (Plate 84, Cat. No. 288983, U.S.N.M.) Gift of Miss Louise Salter Codwise.

180. *Rosary.*—Made of the seeds of the Virginia fringe tree. (*Chioanthus virginica*). The lesser Dominican rosary of five decades The cross is of olive wood from Mount Olive, bound in Japanese silver. Of the same metal are also the figure of Christ and the chain on which the beads are strung. Length, 53 inches.—Washington, District of Columbia. (Plate 85, Cat. No. 275575, U. S. N. M.) Gift of Frederick J. Braendle.

181. *Rosary.*—Made of the Kentucky coffee beans (Gymnocladus dioica). The lesser Dominican rosary of five decades. The cross of olive wood is bound in Japanese silver. Of the same metal is the figure of Christ and the other appurtenances of the crucifix—namely the title (*I N R I*) and the rhomb-shaped nimbus above the figure, the skull and crossbones (for the significance of which see above p. 619) underneath, and the crown of thorns on the back of the

crucifix. Length, 71 inches.—Washington, District of Columbia. (Cat. No. 302930, U.S.N.M.) Gift of Frederick J. Braendle.

182. *Rosary.*—Made of ebony beads. The full or greater Dominican rosary of 15 decades. The cross, which is of the same material as the beads, is bound in silver-plated nickel, with the figure of Christ on one side, and a crown of thorns with a burning heart inside of it, of the same metal, on the other. Length, 6 feet 9½ inches.—Italy. (Cat. No. 179075, U.S.N.M.)

183. *Rosary.*—Made of glass and composition beads. The full or greater Dominican rosary of 15 decades. The beads for the aves are of glass, while those for the paters, as also the three introductory beads, are of composition. Length, 4 feet 4 inches.—Italy. (Cat. No. 179075, U.S.N.M.)

184. *Rosary.*—Made of mahogany beads. The lesser Dominican rosary of five decades. On each of the beads are carved four sets of double circles, or "eyes." The cross (in place of a crucifix) is likewise formed of beads. Length, 5 feet 3 inches.—Italy. (Cat. No. 179075, U.S.N.M.)

185. *Rosary.*—Made of olive-wood beads, carved with intersecting circles. The lesser Dominican rosary of five decades. In place of the crucifix is a bronze medal, three-fourths of an inch in diameter, with the bust of Pius IX and the date 24 (the number of years of his reign) on the obverse; on the reverse is the figure of the Pope, in full pontificals, on his throne, attended by cardinals, and the Latin inscription, "Ecumenical Council, 1869," referring to the Vatican Council which was opened in that year. This rosary was blessed by Pius IX in 1873. Length, 37 inches.—Rome, Italy. (Plate 86, fig. 1, Cat. No. 168294, U.S.N.M.) Collected by Gen. John A. Halderman.

186. *Rosary.*—Made of ivory beads. The lesser Dominican rosary of five decades. The beads for the aves are faceted, while the pater beads are barrel-shaped. In place of the crucifix is a copper medal, 1½ inches in diameter, having on the obverse the image of the Virgin with the Infant Jesus crowned; on the reverse, a much effaced Latin inscription. Length, 40 inches.—Italy. (Plate 86, fig. 2, Cat. No. 179075, U.S.N.M.)

187. *Rosary.*—Made of Job's tears. The lesser Dominican rosary of five decades. The cross of ebony is bound in brass and has the same appurtenances as the one described under No. 182. Length, 33 inches.—Italy. (Plate 86, fig. 3, Cat. No. 179075, U.S.N.M.)

188. *Rosary.*—Made of composition. Consisting of seven sets, each having seven beads. This rosary is used in honor of the seven sorrows of Mary—namely, the prophecy of Simon (Luke ii, 35); the flight into Egypt (Matthew ii, 13); the losing of Jesus in the temple (Luke ii, 48); seeing Jesus carrying the cross (John xix, 17);

standing under the cross (John xix, 25); the piercing of Jesus' side with the lance (John xix, 34); and the lowering of Jesus' body into the sepulcher (Matthew xxvii, 60). In place of the pater beads are seven brass plaques, representing each on one side, Mary with seven swords piercing her heart; on the other, the incidents in Christ's life enumerated above. The cross is formed of brass. Length, 33 inches.—Italy. (Plate 86, fig. 4, Cat. No. 179075, U.S.N.M.)

189. *Rosary.*—Made of blue glass beads. The lesser Dominican rosary of five decades. The five pater beads are of the seeds of the *Abrus precatorius* (called "crabs' eyes," or "jumble beads"). Inclosed in an egg-shaped box of bone. Length, 12 inches; diameters of the box, 1¾ inches.—Madrid, Spain. (Plate 86, fig. 5, Cat. No. 167020, U.S.N.M.)

190. *Rosary.*—Of green glass beads. The lesser Dominican rosary of five decades. In place of the crucifix is an oval brass plaque bearing the image of the Virgin of Guadelupe of Mexico. The paters are marked by double beads of the same size and color as those of the aves. Length, 26 inches.— Mexico. (Cat. No. 179075, U. S. N. M.)

191. *Rosary.*—Of wooden beads, painted black. The lesser Dominican rosary of five decades. Worn at the girdle by members of the Fraternity of Misericordia (*Arciconfraternita de Santa Maria della Misericordia*) in Italy. Length, 50 inches.—Pisa, Italy. (Cat. No. 153893, U.S.N.M.)

192. *Rosary.*—Made of composition. The Franciscan rosary of seven decades. This rosary is used for the devotion in honor of the seven mysteries in the life of Mary—namely, the conception (Luke i, 26); the visitation (Luke i, 39); the nativity (Luke ii); the adoration of the magi (Matthew ii); the presentation (Luke ii, 21); the finding in the temple (Luke ii, 41); and the apparition after the resurrection to Mary. The rosary is provided with two rings for suspending from the girdle. Length, 6 feet, 8 inches.—Italy. (Plate 87, fig. 1, Cat. No. 179075, U.S.N.M.)

193. *Rosary.*—Of black glass beads. The lesser Dominican rosary of five decades. An oval bronze medal, 1¾ and 1⅝ inches in diameter, which takes the place of the crucifix, has on one side the bust of St. Ignatius Loyola (1491-1556), the founder of the Society of Jesus, on the other, the figure of St. John of Nepomuk, the patron saint of Bohemia, who was martyred in 1393. The rosary is provided with two rings to be suspended from the girdle. Length, 55 inches.—Italy. (Plate 87, fig. 2, Cat. No. 179075, U.S.N.M.)

194. *Rosary.*—Of wooden beads. Used in the devotion of the crown of our Lord. Consists of 33 beads for the paters, to commemorate the years of Christ's life on earth, and five for the aves, in honor of the five wounds. The crucifix is substituted by a brass medal, 1½ inches in diameter, engraved with the instruments of the

passion and the Latin words, "The passion of Christ save us, the passion of Christ comfort me." Between the ave beads is inserted a piece of bone, 1½ inches high, carved with the faces of Christ and Mary, and a skull. Length, 47 inches. Italy. (Plate 87, fig. 3, Cat. No. 179075, U.S.N.M.)

195. *Rosary.*—Made of composition beads. Consisting of three sets of nine beads each, separated by an oval brass plaque, which has on one side a representation of the Trinity, on the other, the Gloria in Latin. Length, 21 inches.—Italy. (Plate 87, fig. 4, Cat. No. 179075, U.S.N.M.)

RELIGIOUS ORDERS.

196. *Habit of a Benedictine monk.*—Consisting of a cassock, a scapular (that is, a piece of cloth passing over the head and hanging down over the shoulders), and a cowl. The order of Benedictine monks was founded by St. Benedict of Nursia, Italy, in 529. It was the first monastic order established in the Occident, and its organization became the model upon which all the monasteries of the western church were formed. Common to all monastic orders are the three vows of obedience, chastity, and poverty. The Benedictine monks were bound by their rule to cultivate the land and to read and copy manuscripts.—Italy. (Cat. No. 154312, U.S.N.M.)

197. *Habit of Dominican monk.*—Consisting of a cassock, scapular, and cowl of white wool. The Dominican order was founded by St. Dominic, called de Guzman, in 1204. Its chief original purpose was to preach, especially to infidels and heretics. It is, therefore, called the "preaching order." The Dominicans are also called Black Friars, because of the black cloak worn by them out of doors.—Italy. (Cat. No. 154312b, U.S.N.M.)

198. *Habit of a Capuchin monk.*—Consisting of upper garment, cowl of brown cloth, and rope girdle. The Capuchins are a branch of the Franciscan order, established by Matteo di Bassi, of Urbino, in 1526. They derive their name from the long-pointed capuche, or cowl, which is the distinguishing mark of their dress. Their regulations oblige them to live by begging, and not to use gold, silver, or silk, even in the decoration of their churches and altars.—Italy. (Cat. No. 154312, U.S.N.M.)

199. *Costume of the Fraternity of the Misericordia.*—Consisting of a loose hooded cassock of black stuff, held by a girdle from which a rosary is suspended, and a broad-brimmed felt hat. The Fraternity of the Misericordia (*Pia Arciconfraternita de Santa Maria della Misericordia*) is believed to have been instituted in 1244 and is surviving to the present day in many cities and towns of Italy. Besides taking care for the burial and the performance of the funeral rites of the dead and friendless its members also discharge the function of an ambulance corps, dealing with accidents as they occur and

carrying the sick to the hospitals. Its membership is recruited from all ranks of society, and the active work is carried on by the members in person. The funds needed for the work is obtained by mute appeals of the members in public places and at the doors of churches, for which they hold out an alm box and from the fees of the membership. When on duty the members wear a costume of the cheapest material which completely envelopes and disguises them; even the face is hidden by a covering in which only two holes are left for the eyes.—Pisa, Italy. (Plate 88, Cat. No. 153893, U.S.N.M.)

200. *Devotions in Honor of the Stigmata and Festival of St. Francis of Assisi.*—Printed in 1740 at Rome. St. Francis, born 1182, died 1226, in Assisi, Italy, was the founder of the Franciscan order. According to tradition he received, in 1224, while absorbed in prayer and contemplation on Monte Alverno, the stigmata of Christ—that is, an imitation of the wounds of Christ was miracuously impressed upon his body. He was canonized in 1228.—Rome, Italy. (Cat. No. 2:14724, U.S.N.M.)

201. *Disciplinary girdle.*—Made of wire. It is sometimes worn by monks and other devout persons as a means of mortification and of subduing the passions. Length, 3 feet.—Italy. (Plate 89, fig. 1, Cat. No. 179067, U.S.N.M.)

202. *Disciplinary scourge.*—Made of twisted wire. They are employed by monks and other devout persons as a means of mortification and of subduing the passions.—Italy. (Plate 89, fig. 2, Cat. No. 152252, U.S.N.M.)

SCAPULARS.

Scapular (from middle Latin *scapularis*, pertaining to the shoulders, Latin *scapulae*, shoulder blades, shoulders), is primarily the name given to a portion of the monastic habit in certain religious orders, consisting of a long narrow strip of cloth which passes over the head, covering the shoulders and hanging down in front and behind. With the growth of fraternities of lay people affiliated with the religious orders the practice grew up among devout persons of wearing under the ordinary dress a small scapular consisting of two little pieces of cloth adorned with a picture of the Virgin, a cross or some other religious symbol and joined by strings, in honor of Mary. Certain religious obligations and exercises and sundry spiritual privileges, such as indulgences, are attached to the wearing of it. The scapular was brought into use in the thirteenth century by St. Simon Stock, an Englishman, general of the Carmelite Order.

203. *Scapular.*—Consisting of two pieces of brown cloth, measuring 5½ by 3½ inches, one of which is embroidered with a shield, crown, and crosses; the other with a pelican, the symbol of Christ (see above, p. 618), and connected by strings.—Italy. (Cat. No. 179072, U.S.N.M.)

204. *Scapular.*—Consisting of two pieces of cloth, stamped with the figures of Mary and other saints, and connected by strings. Measurements, 2 by 1¾ inches.—Italy. (Cat. No. 179073, U.S.N.M.)

205. *Scapular.*—Consisting of two pieces of brown cloth, measuring 2⅜ by 1¾ inches, stamped with the figure of Mary crowned, with the infant Jesus, both holding scapulars, with cherubs above and below and the words Na. Sa. del Carmen, our Lady of Carmen (? Carmel).—Italy. (Cat. No. 179074, U.S.N.M.)

206. *Scapular.*—Consisting of two pieces of cotton cloth, measuring 2½ by 2 inches, one of which is stamped on one side with the figure of Christ with a burning heart; on the other, with the figure of a saint and an ostensory. The other is stamped on one side with the figure of Mary with a burning heart; on the other, with the figure of a female saint.—Manila, Philippine Islands. (Cat. No. 216990, U.S.N.M.)

MISCELLANEOUS.

207. *Fish.*—Made of metal. On one side is a Greek cross, on the other the Christ monogram ☧ in relief. With a chain for suspension. The form of a fish was a favorite symbol on the early Christian monuments, alluding to the waters of baptism; also because the initial letters of the Greek word for fish contained the confession "Jesus Christ, Son of God, Saviour." Length, 9 inches.—Italy. (Cat. No. 179010, U.S.N.M.)

208. *Olive palm.*—Palm leaf combined with an olive branch. In some churches in Italy it is blessed by the priest on Palm Sunday and sold at the church door. Protective properties are attributed to it, and it is kept over the bed till the following year. This specimen was blessed at the Santa Felicita Church in Florence, in 1892. Length, 2 feet 5 inches.—Florence, Italy. (Cat. No. 179076, U.S.N.M.)

209. *Certificate of indulgence.*—Manuscript written on vellum. Granted by Pope Alexander VIII (1689–1691), on March 20, 1690, to the Church of the Fraternity of Holy Intercession, in Siena, Italy. Indulgences are granted by the Roman Catholic Church for the remission of the temporal punishment due to sin, after the removal of guilt and eternal punishment of sin in the sacrament of penance, and which must be discharged either in this life or after death in purgatory. The recipient must be in a state of grace, and has to perform certain good works, as giving of alms, fasting, attending mass, making pilgrimages, etc. By way of intercession, indulgences may be applied y the recipient to shorten the sufferings of souls in purgatory. easurements, 15½ by 5½ inches.—Siena, Italy. (Cat. No. 214723, .S.N.M.)

210. *Papal bull.*—Manuscript, written on parchment, dated 1781, ith a leaden seal, having on one side the busts of SS. Peter and Paul; on the other, the name Pius VII (Pope 1775–1799), attached by a

cord of yellow silk. A bull is a document issued by a pope. The name is derived from the Latin *bulla*, a bubble floating upon water; then a boss, a circular plate. In course of time it came to be applied to the leaden seals with which papal and royal documents were authenticated in the Middle Ages, and by a further development the name from designating the seal was eventually attached to the document itself. The seal has always on one side a representation of the Apostles Peter and Paul on the other the name of the reigning Pope, and is attached by a silken cord if it be a "bull of grace," and by one of hemp if a "bull of justice." Measurements of the parchment, 26¾ by 32 inches; diameter of the seal, 1⅝ inches.—Italy. (Cat. No. 179078, U.S.N.M.)

211. *Leaden stamp of Pius II, Pope 1458–1464.*—On one side are represented the heads of SS. Peter and Paul; on the other is the name Pius Papa II. Diameter, $1\frac{7}{16}$ inches.—Italy. (Cat. No. 179105, U.S.N.M.)

212. *Leaden stamp of Clement XI, Pope 1700–1721.*—On one side are the busts of SS. Peter and Paul, with a cross between them; on the other, Clemens Papa XI, with a rayed cross above. Diameter, $1\frac{9}{16}$ inches.—Italy. (Cat. No. 179106, U.S.N.M.)

213. *Leaden stamp of Clement XIII, Pope 1758–1769.*—On one side are the busts of SS. Peter and Paul, with a cross between them; on the other, Clemens Papa XIII, with a rayed cross above. Diameter, 1¾ inches.—Italy. (Cat. No. 179107, U.S.N.M.)

214. *Pontifical album.*—Consisting of 12 colored pictures, showing the Roman Catholic hierarchy and papal attendants.—Rome, Italy. (Cat. No. 179103, U.S.N.M.)

215. *Pontifical album.*—Consisting of 12 colored pictures, showing the officials and attendants of the papal court.—Rome, Italy. (Cat. No. 179104, U.S.N.M.)

216. *Wooden cask.*—Gilded and decorated with the papal arms. Height, 9½ inches; length, 12 inches; diameter, 5½ inches.—Italy. (Cat. No. 152243, U.S.N.M.)

217. *Wooden oval tablet.*—Carved round the edge with leaf pattern, and in the center with the letters J H S (*Jesus hominum salvator*—Jesus Saviour of Mankind) in relief. Diameters, 15 and 11 inches.—Italy. (Cat. No. 179066, U.S.N.M.)

218. *Terra-cotta candlestick.*—From the shaft in the center branch out four arms. With fine moldings. Height, 9½ inches; diameter of the base, 7½ inches.—Italy. (Cat. No. 152245, U.S.N.M.)

219. *Terra-cotta lamp.*—In the center of the top is the Christ monogram ☧ in relief, while round the edge are circles, enclosing each a cross, alternating with loops. Height, 1¼ inches; length, 4¾ inches.—From the Catacombs of Rome, Italy. (Cat. No. 152246, U.S.N.M.)

220. *Terra-cotta lamp.*—On the top the Christ monogram in beaded characters. Height, 1⅝ inches; length, 4½ inches.—From the Catacombs of Rome, Italy. (Cat. No. 152246, U.S.N.M.)

221. *Terra-cotta lamp.*—On top dove holding an olive branch, the symbol of peace, in its bill, surmounted by a winged *caduceus* (the staff of Mercury). Height, 1¼ inches; diameter, 2⅞ inches.—From the Catacombs of Rome, Italy. (Cat. No. 152246, U.S.N.M.)

222. *Delftware flask.*—Decorated with the letters J H S (Jesus Saviour of Mankind). Height, 7½ inches; diameter, 6 inches.—Italy. (Cat. No. 152244, U.S.N.M.)

223. *Jug.*—Of Guadalupe ware. Used by pilgrims to the shrine of Guadalupe, near the City of Mexico, to carry away holy water. Height, 11 inches.—Guadalupe, Mexico. (Cat. No. 179102, U.S.N.M.)

224. *Two corner fixtures.*—Made of brass, openwork. Perhaps used for the corners of the binding of a missal or the Gospels. Measurements, 5½ by 4 inches.—Spain. (Cat. No. 178868, U.S.N.M.)

225. *Panel painting.*—Representing the Virgin and Infant in the sky, and below some worshippers. Signed, P. G. R. 1711. Height, 7⅞ inches; width, 11 inches.—Italy. (Cat. No. 164846, U.S.N.M.)

226. *Church lantern.* (?)—Made of wood, carved, painted, and gilded. Triangular. The columns of the three angles are carved in the form of caryatides, overtopped by a sort of cupola, terminating in a knob. Height, 24 inches; width, 11½ inches.—Italy. (Cat. No. 179039, U.S.N.M.)

227. *Parasol* (*umbrellino*).—The cover is of blue cotton, with trimmings and fringes of yellow silk. Perhaps used to hold over the ostensory when carried in procession. Height, 30 inches.—Italy. (Cat. No. 179019, U.S.N.M.)

II. ECCLESIATICAL ART OF THE EASTERN CHURCH.

The Eastern Church, also called the Greek Catholic, the Orthodox Greek, or, briefly, the Orthodox Church, its full title being the Holy Oriental Orthodox Apostolic Church, is that branch of the Christian church which predominates in eastern Europe and western Asia. The dissolution of union (schism) between the eastern and western parts of the Christian church became definite in 1054, when legates of the Roman pontiff deposited on the great altar of the church of St. Sophia at Constantinople the sentence of excommunication against Caerularius, the patriarch of Constantinople. It was brought about by political and hierarchical, as well as dogmatical and ceremonial differences which arose between western and eastern Christendom, with their representative seats at Rome and Constantinople, in the preceding centuries of the church.

The Greek Catholic Church has, in common with the Roman Catholic Church, the doctrines of seven sacraments, namely, baptism, chrism (confirmation), penance (preceded by confession), eucharist (the Lord's supper), ordination, marriage, and extreme unction; besides the sacrifice of the mass; the religious veneration of Mary, the saints, images, relics, and the cross; the hierarchical degrees; and monasticism.

Its peculiar tenets are mainly as follows: It adheres only to the decrees of the first seven ecumenical councils. It teaches the procession of the Holy Ghost from the Father alone. It denies the dogmas of the immaculate conception of Mary and of the supremacy and infallibility of the Roman pontiff, and rejects the doctrine of purgatory, of works of supererogation, and indulgences, but prays for the dead that God would have mercy on them on the day of judgment.

Its ritual and ceremonial differences from those of the Western Church are chiefly the following: Baptism is administered by threefold immersion; chrism (confirmation) is conferred immediately after baptism and by a priest (not by a bishop); in communion both bread and wine are given to the laity and even to infants, the bread being put into the wine; anointing (extreme unction) is performed on the sick, not the dying; and fasts are kept on Wednesday and Friday.

The clergy of the Greek Catholic Church are divided into two classes—the black clergy (so called from their dress), or monks, and the white, or secular clergy. The former live in celibacy, and from among them are chosen the higher hierarchical grades—that is, the patriarchs, metropolits, archbishops, and bishops. The lower secular clergy, comprising popes (priests), deacons, subdeacons, and readers, must be married before receiving orders, but can not marry a second time.

The churches of the Greek Catholic Church are mostly built in form of a cross. In Russia they are generally crowned with one or more cupolas of a bulbous shape, which are surmounted by a cross. Sometimes there is a belfry standing separate from the church. The altar space, which usually faces east, is divided from the main body of the church by a board partition, called iconostas (image stand), which is covered with images of Christ and the saints, and contains three doors. The service is performed behind this screen, and only at certain stages are the middle doors, called the "sacred," or "royal gates," opened. There are no benches in the churches, the people standing during service. No organ or any other instrumental music is permitted, but the mass is generally accompanied by choral singing, and the choirs are composed entirely of men and boys.

The Orthodox Church consists at the present of 16 separate independent branches, who profess the same faith, use the same liturgy (though in different languages), and are in communion with one another. They are: 1–4, the patriarchates of Constantinople, Alexandria in Egypt, Antioch in Syria, and Jerusalem in Palestine; 5, Cyprus; 6, Russia; 7, Carlowitz; 8, Hermannstadt (both in Austria-Hungary); 9, Czernowitz in the Bukovina; 10, Bosnia and Herzegovina; 11, Serbia; 12, Montenegro; 13, Bulgaria; 14, Rumania; 15, Greece, and 16, Mount Sinai, consisting of only the monastery.

THE RUSSIAN ORTHODOX CHURCH.

Russia received its Christianity in the tenth century, under Olga and Vladimir the Great (984–1015), from Constantinople. The Russian Church entirely agrees in doctrine and ritual with the other branches of the Orthodox Church, while in administration it is distinct. At first under the jurisdiction of the patriarch of Constantinople, it became in 1589 independent, establishing its own patriarch in Moscow. Peter the Great (1689–1725) abolished the patriarchate and set up the Holy Directing Synod in 1721 to rule the church of Russia.[1]

The church in Russia is administered by 86 bishops, of whom 3, those of Kiev, Moscow, and Petrograd, are always metropolits, and 14 are archbishops. There are 481 monasteries for men and 249 convents for nuns. In America the Russian Church is represented by an archbishop of Aleutia and North America with two suffragans, the bishops of Alaska (with residence in San Francisco), and Brooklyn.

There are in Russia a great number of sects, most of which acknowledge the doctrinal basis of the oriental church, but reject the liturgy of the Russian Church as changed by the patriarch Nicon (1654). They are called by the state church *Rascolniki* (separatists), while they call themselves *Starnovyertzi* (of the old faith).

228. *Russian cover for altar table.*—Made of purple croisson silk, with a cross in the center. The sanctuary in an eastern church is separated from the main body of church by the image screen (iconostas), and the laity is not allowed there. In the middle, before the "royal gates," stands the altar, called "throne," a solid square stone, covered with a linen cloth down to the ground all around. Over the linen cloth is laid a covering of some rich material, representing the "glory of God." Besides the "throne" is another table, called the "altar of sacrifice" (*prothesis*), on which are the sacred vessels used in the celebration of the mass. These consist of the chalice, paten, which is much larger and deeper than the one used in the Roman Catholic Church; the star—that is, a cross of bent metal which stands over the paten holding the veils which cover the paten and chalice; a spoon for giving communion to the people, a

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[1] Since the revolution of 1917 the patriarchate of Moscow has been restored.

knife in form of a lance, in allusion to the lance which pierced the side of Christ (John xix, 34), with which the bread for the Eucharist is cut up; and two fans, made of a long handle and a flat representation of a seraph with six wings (Isaiah vi, 2), which the deacon waves over the sacrament. Length, 37½ inches; width, 34 inches.—Nizhni Novgorod, Russia. (Cat. No. 154785, U.S.N.M.)

229. *Russian cover for altar table.*—Made of striped silk, with two crosses in silver appliqué. Length, 6 feet 2 inches; width, 2 feet 1 inch.—Nizhni Novgorod, Russia. (Cat. No. 154788, U.S.N.M.)

230. *Old Russian Church candlestick.*—Made of brass. The back, somewhat in form of a harp, terminates on the end in three flames, arranged in the form of a cross. From the back, which was fastened to the wall, run out five arms in a semicircle. Height, 13 inches; width, 12½ inches 9 inches.—Washington, D. C. (Cat. No. 251899, U.S.N.M.)

231. *Russian funerary pall.*—Made in form of a cross, with the four ends, or wings, to hang down the sides. The center, or top cover, is of yellow silk; the ends are of black velvet. On each of the narrow ends is a double cross of cream colored silk sewed on. On the wide ends is in each corner a skull and crossbones of the same material and workmanship as the crosses on the narrow ends, while in the center of each is a painted oval representing the angel announcing the resurrection of Christ to the two Marys at the tomb (Matthew XXVIII, 1–6). Length, 10 feet 4 inches; width, 6 feet 4½ inches.—Nizhni Novgorod, Russia. (Cat. No. 179110, U.S.N.M.)

ECCLESIASTICAL VESTMENTS.

The full canonicals of a Greek Catholic priest are: 1, *stoicharion,* a loose shirtlike garment with wide sleeves and reaching to the feet, of any stuff or color, corresponding to the Roman Catholic alb; 2, *epimanikia,* cuffs, made of silk or brocade and reaching about halfway from the wrist to the elbow; 3, *epitrachelion,* corresponding to and resembling the Latin stole, only instead of being thrown around the neck, the head is put through a hole in the upper end and it hangs down in front nearly to the feet; 4, *zone,* girdle; and 5, *phaenolion,* chasuble, a bell-shaped garment with short wide sleeves, with a hole through which the head is put, reaching to the feet behind and at the sides and usually scooped out in front. Priests of a higher rank (Protopopes in Russia) wear in addition, the *epigonation,* a rhomb or lozenge-shaped piece of stiff brocade, about 12 inches in length, suspended from the girdle at the right side, symbolizing the sword of the Spirit. The priest's every-day attire is a cassock of any sober color.

The bishop's liturgical vestments are generally more ornamental than those of a priest, being embroidered with crosses and figures of the Virgin and of saints. His *stoicharion* has red and white bands running from the shoulders to the feet, and embroidered at the bottom. The *epitrachelion* is worn around the neck and hangs down in the front. In place of the *phaenolion* the bishop wears a *sakkos*, a tunic of puce-colored satin reaching to below the knees, with short sleeves, divided up the sides which are joined by bows of ribbons or clasps. Over this comes the *omophorion*, a wide band of silk or velvet passed round the neck, one end hanging down from the left side in front, the other behind, and kept in its place with ornamental pins. The pontifical miter is a high hat which swells out toward the top and is spanned diagonally by two hoops; on the highest point of the dome-shaped top is a cross, either standing upright or placed flat. The bishop also wears a pectoral cross and a medallion with the image of the Virgin and Infant, called the *panagia* or *enkolpion*, and carries a pastoral staff or crozier (*dikanikion*).

The deacon wears the *stoicharion*, the *epimanikia*, and the *epitrachelion*, called *orarion*, which hangs from the left shoulder, to which it is pinned, straight to the ground before and behind.

232. *Russian priests' phaenolion.*—Made of heavy gold brocade, with a Greek cross in gold appliqué, lined with silver appliqué, on the back.—Nizhni Novgorod, Russia. (Plate 90, Cat. No. 154783, U.S.N.M.)

233. *Russian priests' phaenolion.*—Made of gold and purple silk brocade, with Greek cross in gold and silver appliqué on the back.—Nizhni Novgorod, Russia. (Cat. No. 154784, U.S.N.M.)

234. *Pastoral staff of a Greek Catholic bishop.*—Made of copper tubes, silvered, terminating at the top into two serpents bent into a handle, giving it the appearance of an anchor, the emblem of hope, with a cross surmounting an orb between them. The handle and the cross are gilded. Height, 5 feet 2 inches.—Constantinople, Turkey. (Plate 91, fig. 1, Cat. No. 154797, U.S.N.M.)

235. *Costume of a Greek Catholic monk.*—Consisting of—1, inner coat; 2, soutana; 3, outer coat; 4, girdle; 5, shoes with goloshes; 6, cylindrical hat, called *Kalemaukion*, without a brim below, but with a narrow rim at the top. It is worn by all ecclesiastics with the other vestments out of doors and in processions.—Constantinople, Turkey. (Plate 92, fig. 1, Cat. No. 154773, U.S.N.M.)

RUSSIAN ICONS AND CROSSES.

The Greek Orthodox Church does not admit sculptured figures into the churches (though they often have numerous statues upon the outside), perhaps because they are reminiscent of the Greek gods. The eastern icon—that is, image of Christ, Mary, the angles, and saints—is always flat; a painting, mosaic, or bas-relief. To imitate an effect of sculpture in the painted pictures placed upon the iconostas or the screen which divides the sanctuary from the main body of the church, the icon, which is generally painted upon wood, is covered, excepting the face and hands, with a raised relief of silver, gold, or pearls, and precious stones, showing all the details and curves of the drapery, clothing, and halo around the flat painted face and hands of the icon. In many Russian churches not only all the wall space but the surface of the columns as well is covered with pictures representing scenes from the Bible or the lives of the saints or religious heroes. Before the icons candlesticks or large lamps are lighted. In the homes such a picture is usually put up in the corner of a room, and before it a lamp burns and devotions are performed. Devout persons wear on a little chain around the neck a small cross or sacred image given them on the day of baptism.

The cross usually seen in the Russian Church is three-barred, of which the upper bar represents the title of the cross (John xix, 19); the second, the arms; and the lowest, which is always inclined at an angle, the foot rest (*suppedaneum*), on the assumption that one foot of Christ, when suffering, was drawn higher than the other.

There are in the museum's collection over 300 icons and crosses, the larger part of brass. A selection from them will be noted below.

236. *Russian icon, Mary with infant.*—Covered with a silver gilt plate of chased work to represent the clothing, with apertures for faces and hands. Studded with fresh-water pearls, emeralds, ruby spinels, and garnets, which date from the eleventh to the fourteenth century, as they are all drilled and were used for some other purpose before they were put in the frame of the icon. The pictures on the folding doors, representing scenes from the lives of Christ and Mary, were painted by the artist who designed and decorated the cathedral of Nizhni Novgorod, about 1645. Height, 13¼ inches; width, 17¼, inches.—Nizhni Novgorod, Russia. (Plate 93, Cat. No. 154779 U.S.N.M.)

237. *Russian icon, Mary with infant.*—Painted on wood. Height, 6¾ inches; width, 4¾ inches.—Nizhni Novgorod, Russia. (Cat. No. 154778, U.S.N.M.)

238. *Miniature of Christ and Mary.*—Oval, painted on porcelaine Christ is represented in half figure, with long hair falling behind, face slightly turned to the left, and hands folded on the bosom. He is covered with a green cloak which leaves his bosom and left arm free. Mary's minute bust is above, with red garment down over her head. She is represented with hands extended rising above the clouds or, looking down from heaven. The porcelain is set in a silver gilt frame, which is provided with a loop for suspension, indicating that it was worn as a medallion. An inscription in Russia reads, "Moscow. April 13, 1796." Diameters, 2⅜ and 1$\frac{15}{16}$ inches. (Cat. No. 293052,

U.S.N.M.) Gift of Abraham Burnstine, Washington, District of Columbia.

239. *Miniature head of Christ.*—Painted on wood from the cabin built by Peter the Great (1682–1725) and lacquered. Height, $2\frac{3}{16}$ inches; width, $1\frac{7}{8}$ inches.—Russia. (Cat. No. 281569, U.S.N.M.) Bequest of Homer N. Lockwood.

240. *Russian icon, the Holy Family.*—Painted on wood. Height, $2\frac{5}{8}$ inches; width, $2\frac{1}{8}$ inches.—Nizhni Novgorod, Russia. (Cat. No. 154777, U.S.N.M.)

241. *Russian icon, Cosmas and Damianus.*—Painted on wood. Cosmas and Damianus were two brothers who died as martyrs in the persecution of the Christians under the Roman Emperor Diocletian (303–311 A. D.). Height, $8\frac{3}{4}$ inches; width, $6\frac{3}{4}$ inches.—Nizhni Novgorod, Russia. (Cat. No. 154781, U.S.N.M.)

242. *Russian icon.*—Consisting of a brass triptych. In the center is the Virgin with the Infant; above, God the Father; in the two wings, scenes from the life of Christ.—Nizhni Novgorod, Russia. (Plate 94, fig. 1, Cat. No. 179–120, U.S.N.M.)

243. *Russian icon.*—Made of brass. In the center Christ seated, holding in the left hand the Gospels and with the right giving the blessing, surrounded by the Twelve Apostles. Above in a shield, God the Father, holding in his left hand the orb, surmounted by a cross, and with the right hand giving the blessing, and beneath the shield the dove, symbol of the Holy Ghost, and the whole surmounted by six seraphim, each with six wings (Isaiah vi, 2).—Nizhni Novgorod, Russia. (Plate 94, fig. 2, Cat. No. 179113, U.S.N.M.)

244. *Russian cross.*—Made of brass. Representing, in relief, the crucifixion. On top, God the Father and the dove (as in the preceding); under the third oblique bar (the *suppedaneum*) a skull and cross bones.—Nizhni Novgorod, Russia. (Plate 94, fig. 3, Cat. No. 179111, U.S.N.M.)

245. *Russian icon.*—Consisting of a brass tetraptych, representing in 20 compartments, in relief, scenes from the life of Christ.—Russia. (Plate 95, Cat. No. 211164, U.S.N.M.)

LITURGICAL BOOKS.

The liturgies used in the orthodox communities belong to the Byzantine rite. This rite comprises three liturgies—that of St. John Chrysostom, patriarch of Constantinople (died 407); that of St. Basil the Great, bishop of Caesarea in Cappodocia, Asia Minor (died 379); and that of St. Gregory Dialogos (Pope Gregory I, 590-604), also called the liturgy of the presanctified. The two latter are used only on special days, while that of St. Chrysostom is the ordinary liturgy. While the ritual is the same in all the branches of the Orthodox Church, the language in which it is recited is that of each people, only usually in the archaic form. Thus, in the Greek-speaking communities it is the old Greek; among the Slavs it is old Slavonik; Rumanian is used by the church of that country and the Rumanians in Hungary; while Syriac is the church language in some parts of Syria.

246. *Manual of the services of the Orthodox Church.*—Containing a description of the services, rites, and ceremonies of the Greek Orthodox Church, with illustrations. Compiled by Archpriest D. Sokolof Translated from the Russian. Printed in New York and Albany, 1899.—Sitka, Alaska. (Cat. No. 259114, U.S.N.M.) Gift of Rev. A. P. Kashevaroff.

247. *The divine liturgies of our fathers among the Saints John Chrysostom and Basil the Great, with that of the Presanctified.*—Edited with Greek text by J. N. W. B.-Robertson. Printed in black and red letters. The black letters contain the text of the liturgies, while the red the rubrics or directions in performing the various actions of the service, with a colored plate, representing the crucifixion. London, 1894.—Sitka, Alaska. (Cat. No. 259107, U.S.N.M.) Gift of Rev. A. P. Kashevaroff.

248. *Octoëchos, or Book of Eight Tones.*—Containing the commemorations, or collects, for each day of the week—namely: Sunday of the resurrection, Monday of the angels, Tuesday of John the Baptist and the other prophets, Wednesday of Mary, Thursday of the apostles and St. Nicholas, Friday of the cross, and Saturday of the saints. They are sung in eight varied tones, covering a cycle of eight weeks, hence the name Octoëchos. Translated from the Slavic by Prof. N. Orloff. Printed in London, 1898.—Sitka, Alaska. (Cat. No. 259109, U.S.N.M.) Gift of Rev. A. P. Kashevaroff.

249. *Horologion, or Book of Hours.*—Containing the daily devotions for the stated or canonical hours. Translated from the Slavic by Prof. N. Orloff. Printed in London, 1897.—Sitka, Alaska. (Cat. No. 259681, U. S.N.M.) Gift of Rev. A. P. Kashevaroff.

250. *Trebnik, or Book of Needs.*—Containing the prayers and services performed on various occasions, such as churching of a woman, baptism, confession, marriage, visiting the sick, burial. Translated from the Slavic by S. V. Shann. Printed in London, 1894.—Sitka, Alaska. (Cat. No. 259108, U.S.N.M.) Gift of Rev. A. P. Kashevaroff.

III. ECCLESIASTICAL ART OF THE ARMENIAN CHURCH.

The territory which once formed the Kingdom of Armenia, is the tableland situated between Asia Minor and the Caspian Sea, inclosed on several sides by the ranges of the Taurus and Anti-Taurus, and partly traversed by other mountains, the highest of which is the volcanic peak of the Ararat mentioned in the Old Testament.

Armenian people appear in history about the middle of the sixth century B. C. The last refuge of Armenian independence was destroyed by the Mamelukes in 1375, and the country is now divided between Turkey, Russia, and Persia.

The establishment of Christianity in Armenia is ascribed to St. Gregory the Illuminator, the apostle of Armenia. Certain is that Christianity at an early date passed from Syria over into Armenia, and that the Bible was translated into Armenian in the fifth century.

The Armenian Church agrees in many doctrines and practices with the Greek Orthodox Church. It teaches the procession of the Holy Ghost from the Father only, but maintains the formula of one nature in Christ (*monophysitism*). Baptism is performed by partially immersing and then thrice pouring water on the head of the person. Confirmation is performed by the priest at baptism. The Lord's Supper is administered in both kinds, the broken bread or wafer (unleavened) being dipped in undiluted wine and laid on the tongue of the fasting communicant. Like the Roman Catholic Church the Armenian Church professes belief in seven sacraments, in transubstantiation, and adores the host in mass, but rejects the doctrine of purgatory, though prayers are offered for the dead. It venerates the cross, the saints and their pictures, and insists on the perpetual virginity of Mary. The church services are performed in the ancient Armenian language.

There are kept by the Armenian Church 105 fast days, when no animal food can be eaten; 14 great feast days observed more strictly than Sunday; and more minor feasts than days of the year.

The clergy of the Armenian Church is divided into nine grades or orders: The catholicos, who is at the head of the entire hierarchy with his seat at Etchmiadzin, near Erivan, the capital of Russian Armenia; patriarchs; archbishops; bishops; priests; deacons; subdeacons; porters; readers; exorcists; and candle lighters. The priests are divided into two classes—the doctors or teachers (*vartabeds*), who must live in celibacy; and the parish priests, who must marry before attaining the rank of subdeacon. Besides the secular clergy there are also monks in the Armenian Church.

Armenian church buildings are usually small and have massive walls, sometimes 7 or 8 feet thick, and very small windows. They are square and are adorned with a polygonal tower terminating in a short spire.

251. *Costume of an Armenian priest.*—Consisting of—1, tunic; 2, soutana; 3, girdle; 4, shoes with galoshes; 5, cylindrical hat of blue velvet, with waulted and fluted top.—Constantinople, Turkey. (Plate 92, fig. 2, Cat. No. 154774, U.S.N.M.)

252. *Armenian patriarch's staff.*—Made of copper, silvered, terminating in a gilded orb surmounted by a cross. Height, 5 feet 9

inches.—Constantinople, Turkey. (Plate 91, fig. 2, Cat. No. 154796, U.S.N.M.)

253. *Keshotz.*—Made of white metal. A musical instrument in form of a rayed circle, somewhat like the halo round the head of a saint, with 10 gilded globular tinklers attached on the edge. In the middle of the circle is a six-winged seraph (Isaiah vi, 2). At certain parts of the celebration of the mass this instrument is shaken with the object, as the ringing of the altar bell in Roman Catholic churches, to excite the attention and devotion of the congregation. Height, 19 inches; diameters, 11½ and 9½ inches.—Constantinople, Turkey. (Plate 96, fig. 1, Cat. No. 154799, U.S N M.)

254. *Cross of benediction.*—Made of white metal. Used when giving the blessing to the congregation by an ecclesiastic. The Armenian cross differs from the Latin cross by the arms being nearer the top and much shorter. Height, 9½ inches; width, 5½ inches.—Constantinople, Turkey. (Plate 96, fig. 2, Cat. No. 154798, U.S.N.M.)

255. *Flute.*—Used for accompanying the chanting of the mass in the Armenian Church. The Armenian Church makes no use of the organ. Length, 31 inches.—Constantinople, Turkey. (Plate 97, fig. 1, Cat. No. 154802, U.S.N.M.)

256. *Triangle.*—Used during the service of the mass in the Armenian Church. Height, 7 inches; base 6 inches.—Constantinople, Turkey. (Plate 97, fig. 2, Cat. No. 154805, U.S.N.M.)

257. *Double bell.*—Made of white metal. Used at the conclusion of the service of the mass in the Armenian Church. Height, 8 inches; diameters, 3¾ and 3 inches.—Constantinople, Turkey. (Plate 97, fig. 3, Cat. No. 154801, U.S.N.M.)

258. *Cymbal.*—Used in the service of the mass in the Armenian Church. It is struck with a hammer, and the secret of its manufacture is said to be known to but one artisan in Constantinople. Diameter, 15 inches.—Constantinople, Turkey. (Plate 97, fig. 4, Cat. No. 154803, U.S.N.M.)

259. *Pair of cymbals.*—Called by the Armenians *Dzindzgha.* Used in the service of the mass in the Armenian Church. Diameter, 11 inches.—Constantinople, Turkey. (Cat. No. 154804, U.S.N.M.)

MODELS OF ECCLESIASTICAL EDIFICES.

260. *Models of the cathedral, the baptistery, the Campanile or Leaning Tower, and the Campo Santo of Pisa, Italy.*—Made of alabaster and mounted upon a tablet of black marble. The cathedral (*duomo*) was begun in 1063 (or 1067) and consecrated in 1118. It is a basilica of the romanesque style of architecture. Its plan is a Latin cross, 311 feet long, 106½ feet across the nave, and four aisles, 237 feet across the transept, and 91 feet high, to the wooden ceiling of the nave. Over the apse is a semidome. The façade has five superposed tiers

of arcades with small columns, and a similar arcade is carried round the edifice under the roof. The baptistery which stands in front of the cathedral, erected between 1154 and 1350, is a circular structure with a dome, surmounted by a statue of John the Baptist. It also has two tiers of superposed arcades. Its height is 180 feet; the diameter inside is nearly 100 feet, outside 107 feet, so that the walls are about 8 feet thick. The dome is 60 feet in diameter and is supported on four piers and eight pillars. The campanile or leaning tower was in process of construction one hundred and seventy-odd years, 1174–1350. It is a cylindrical structure in eight stories. The lower story, which is solid, has a height of 35 feet and is adorned with 15 three-quarter columns. The six stories above this average 20 feet in height, and are surrounded with an open arcade. The whole is crowned with a similar circular tower, 27 feet high, in which the bells are hung. The entire height is thus 182 feet. The diameter at the base is 52 feet. The tower, in consequence of the giving away of the foundations before the fifth story was reached, leans 11 feet 2 inches out of the perpendicular, and adding the 1 foot 10 inches of the projecting cornice, it overhangs the base by 13 feet.

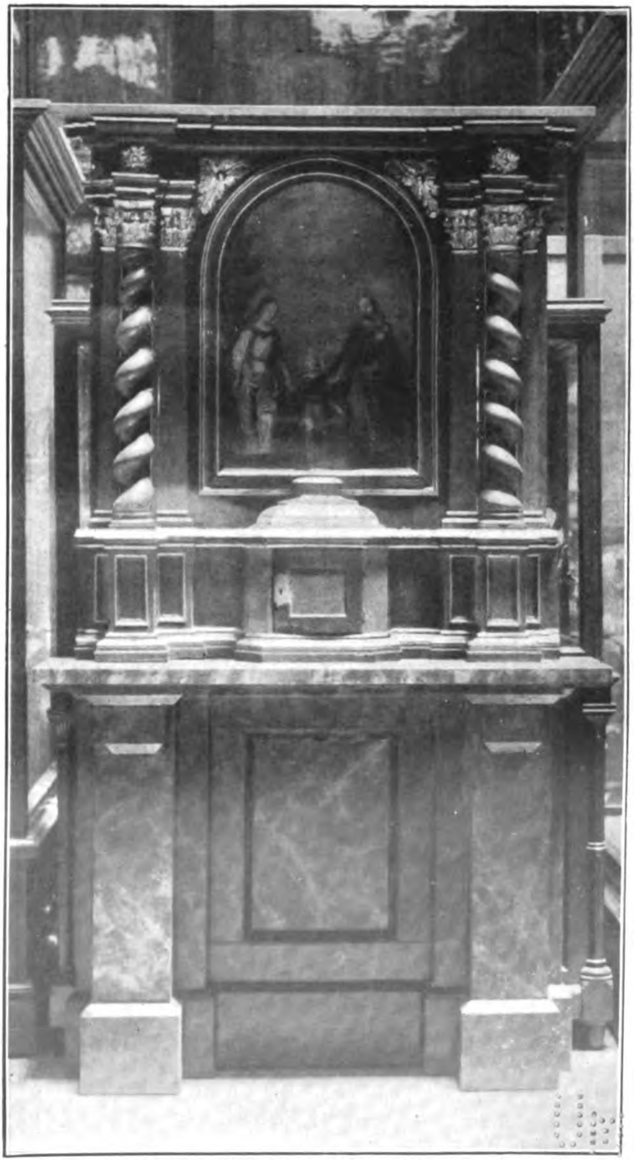
The Campo Santo, or burial place, was begun in 1278 and completed in 1464. It is an oblong building with a square tower in front, surmounted by a cupola. It contains among others the tomb of Henry VII, Emperor of Germany 1308–1313. It is a veritable museum of medieval painting and sculpture. Height of the baptistery of the model, 2½ inches.—Pisa, Italy. (Cat. No. 217751, U.S.N.M.) Gift of Mrs. Charlotte Emerson Main.

261. *Model of a church in Borgund, Norway.*—Made of wood. The church is a wooden structure, with many pinnacles, giving it the aspect of a Chinese pagoda and suggesting the "house of seven gables." This style of church architecture was at one time very common in Norway, but is fast disappearing. Height, 8 inches; length, 7¾ inches; width, 5⅛ inches.—Norway. (Cat. No. 249675, U.S.N.M.). Gift of Miss Eliza R. Scidmore.

262. *Model of the tabernacle of the Church of Jesus Christ of Latter Day Saints in Salt Lake City, Utah.*—Made of wood. The tabernacle, built in 1864–1867, is in the shape of an oval or ellipse, 250 feet long, 150 feet wide, and 80 feet high. It is covered with a wooden roof with iron shingles, resembling a turtle shell, which rests upon 44 buttresses of sandstone, but unsupported by pillars or beams, so that the interior presents one of the largest unsupported arches in the world. Between the buttresses are 20 large double doors opening outward and affording speedy egress. Inside the building is surrounded by a gallery, except at the west end where there are a platform for speakers, seats for the choir, and one of the largest organs, comprising 500 pipes. The building which is used for public religi-

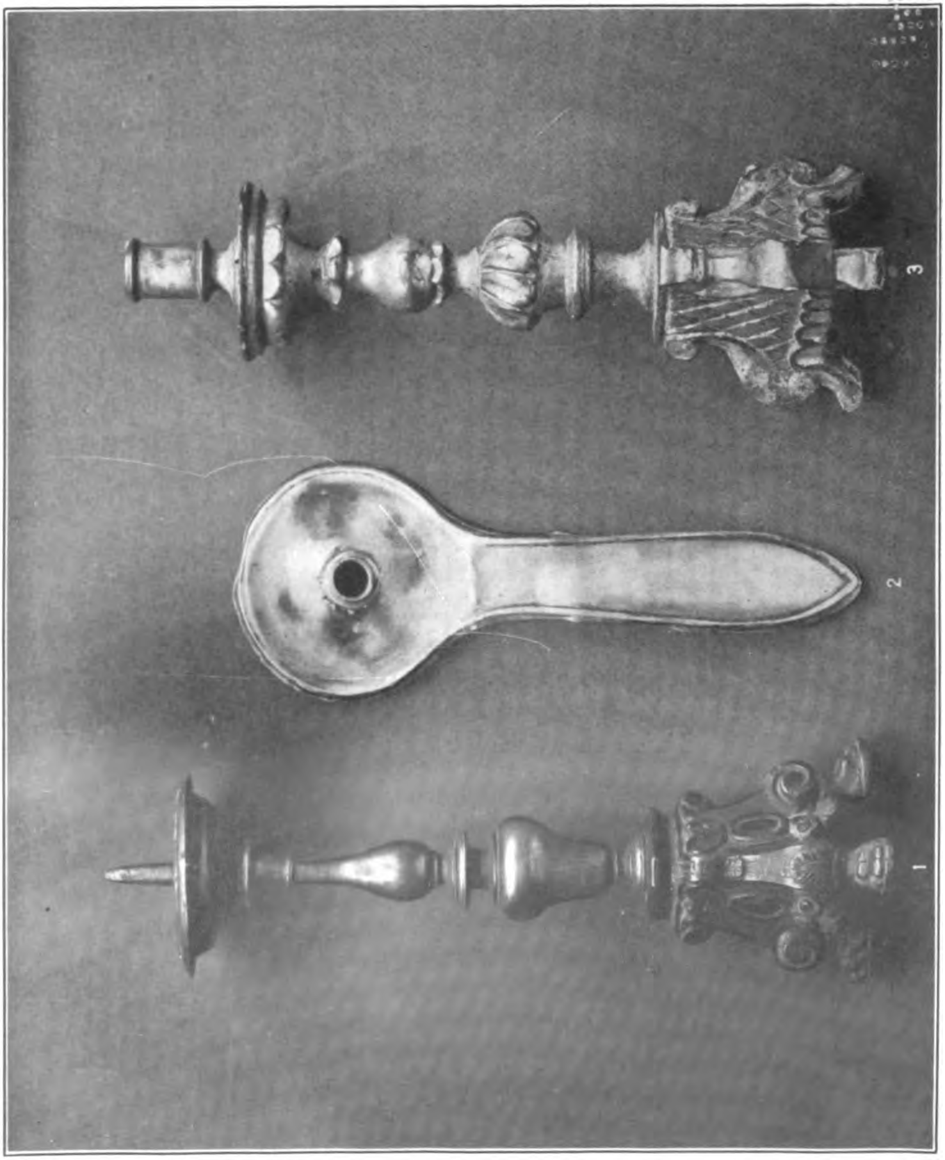
ous services on Sunday afternoons, for lectures, sacred concerts, and other meetings, has a seating capacity for 8,000 people, but can accommodate about 10,000, and is well adapted for speaking and hearing. It is said that a pin dropped at one end of the hall may be heard distinctly at the other end, over 200 feet away. The model shows the arrangement of the interior in detail and also the organ. Height, 31 inches; length, 7 feet; width, 4 feet 2 inches.—Salt Lake City, Utah. (Cat. No. 258396, U.S.N.M.) Gift of the committee of the Church of Jesus Christ of Latter Day Saints.

263. *Temple of the Church of Jesus Christ of Latter Day Saints in Salt Lake City, Utah.*—Made of plaster of Paris. The temple is built mainly of gray granite, quarried from the Wasatch Mountains, and it required 40 years (1853–1893) for its construction. It is 186 feet long from east to west and 99 feet wide. The walls are 6 feet thick. At each corner are three pointed towers, the loftiest of which, in the center of the eastern or principal façade, is 210 feet high, and is surmounted by a gilded copper statue, 12 feet 6 inches high, of the angel Moroni. The temple is used for the administration of ordinances, as baptism, marriage, ordination, also for theological lectures, preaching, prayer, etc. Height, 5 feet 4 inches; length, 5 feet 3 inches; width, 3 feet 4 inches.—Salt Lake City, Utah. (Cat. No. 258397, U.S.N.M.) Gift of the committee of the Church of Jesus Christ of Latter Day Saints.



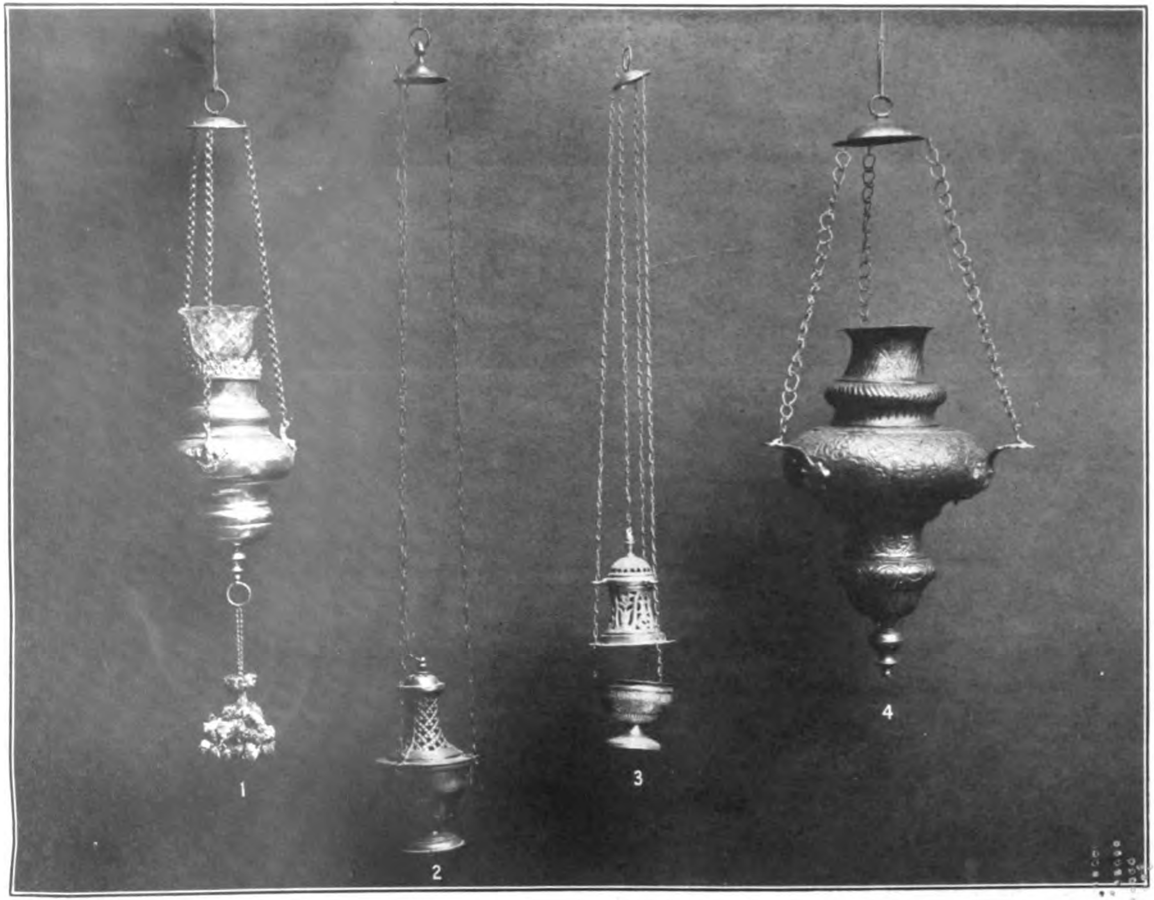
ROMAN CATHOLIC ALTAR FROM GERMANY

FOR DESCRIPTION SEE PAGE 607.



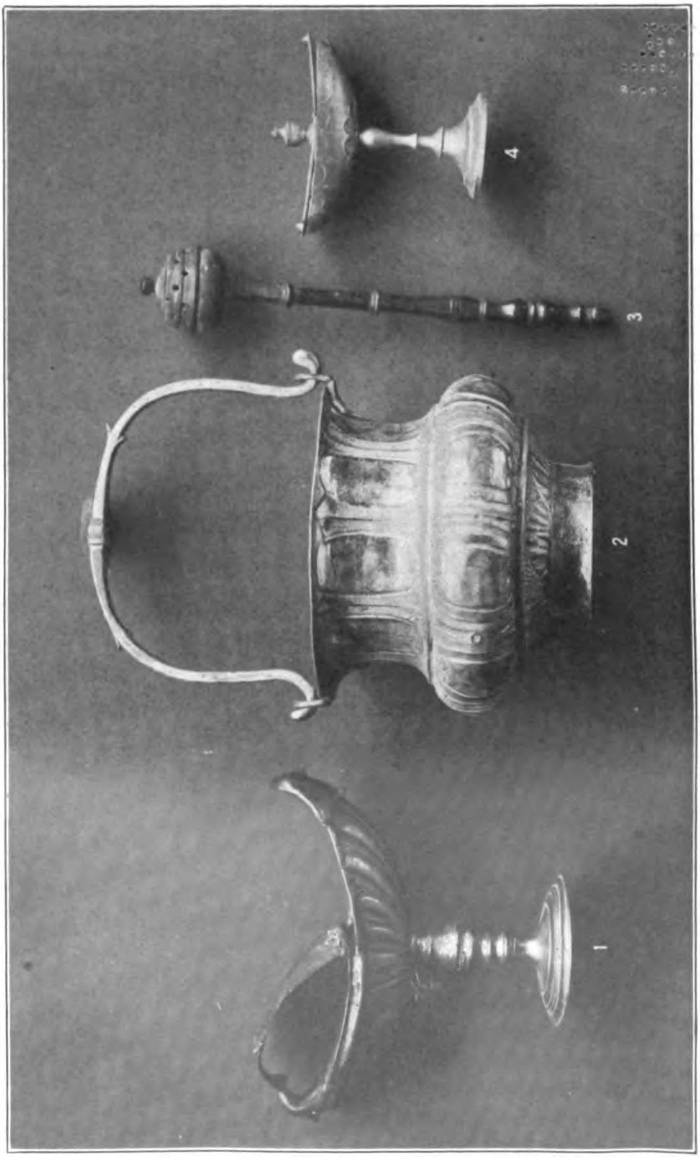
ECCLESIASTICAL CANDLESTICKS FROM SOUTHERN EUROPE

FOR DESCRIPTION SEE PAGE 607



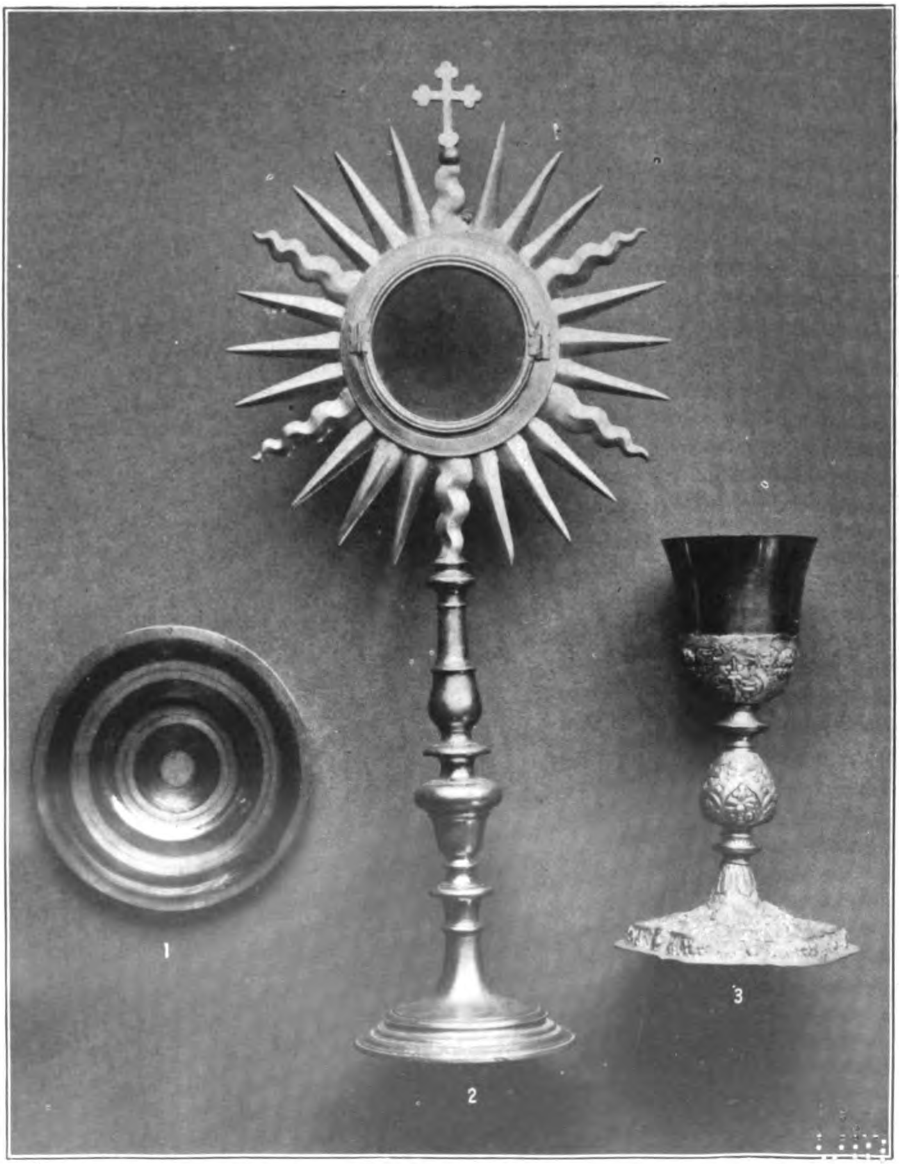
ALTAR LAMPS AND CENSERS.

FOR DESCRIPTION SEE PAGES 607 AND 608.



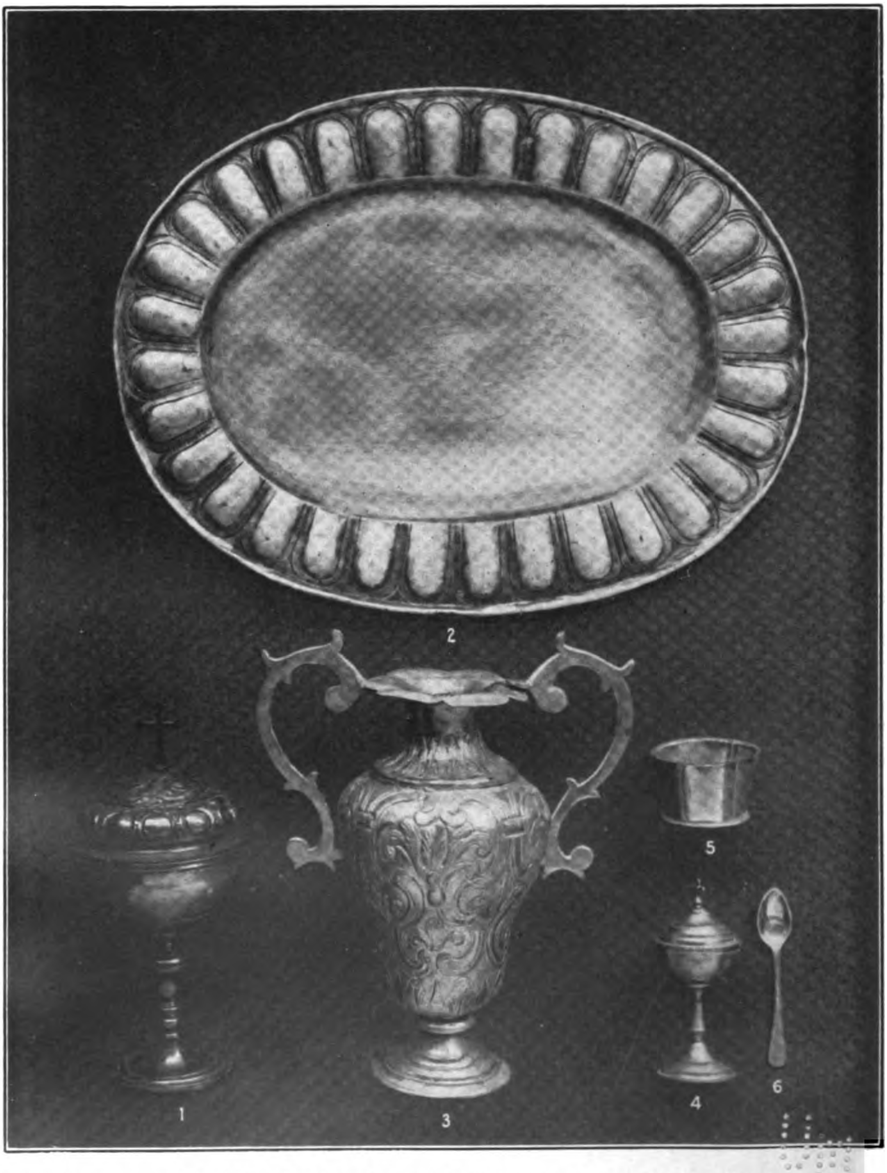
INCENSE BOATS (1 AND 4), HOLY WATER VESSEL (2), AND SPRINKLER (3).

FOR DESCRIPTION SEE PAGE 608.



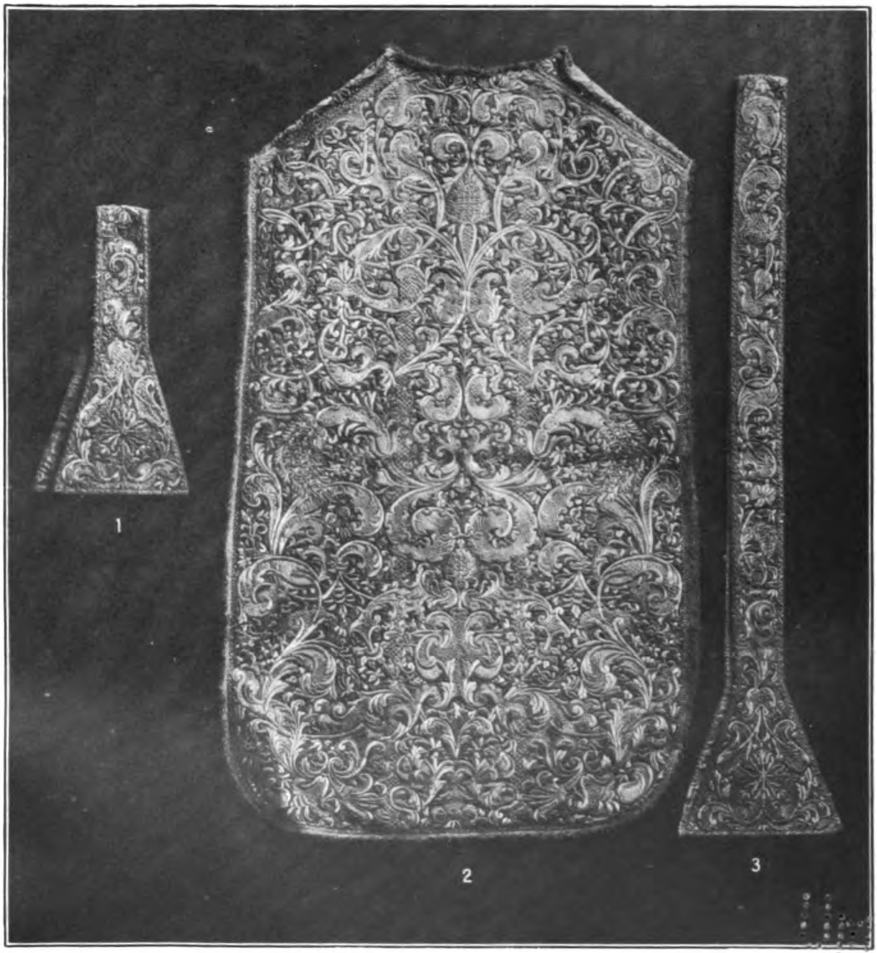
PATEN (1) AND CHALICE (3) AND OSTENSORY (2).

FOR DESCRIPTION SEE PAGES 608 AND 615.



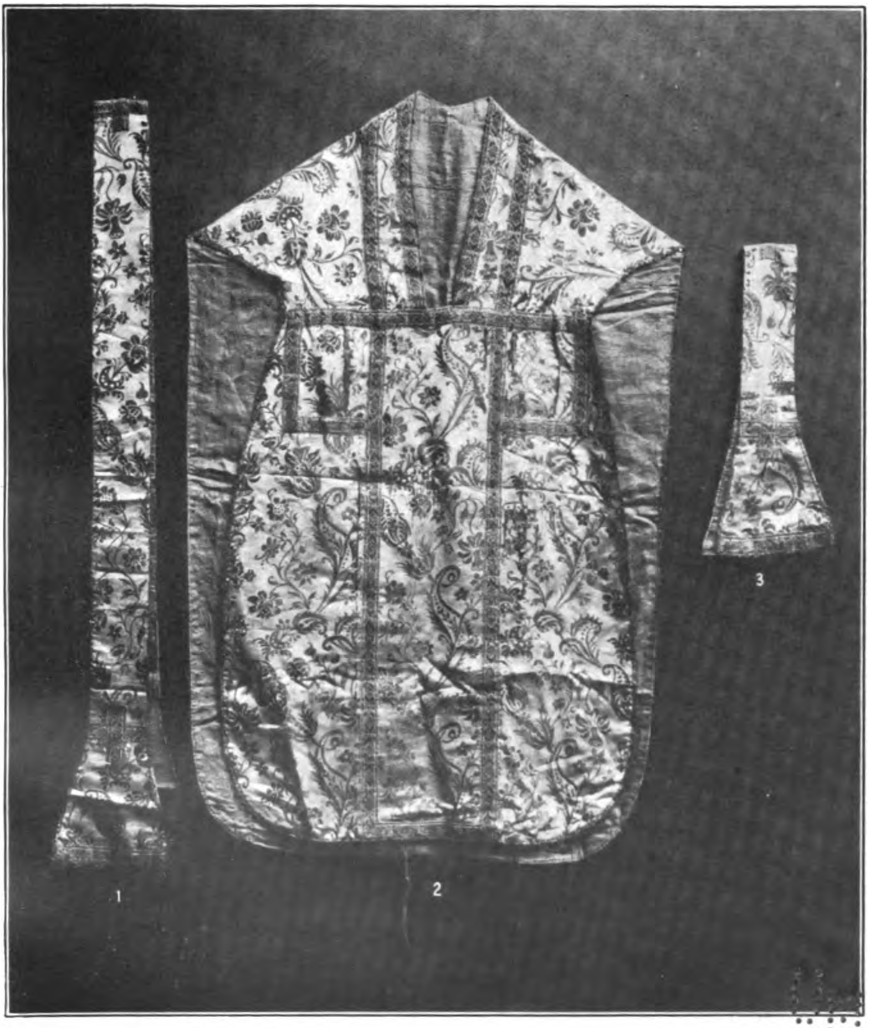
Cibory (1), Tray (2), Urn (3), Pyx (4), and Cup (5) and Spoon (6) for Holy Chrism.

For description see pages 609 and 614.



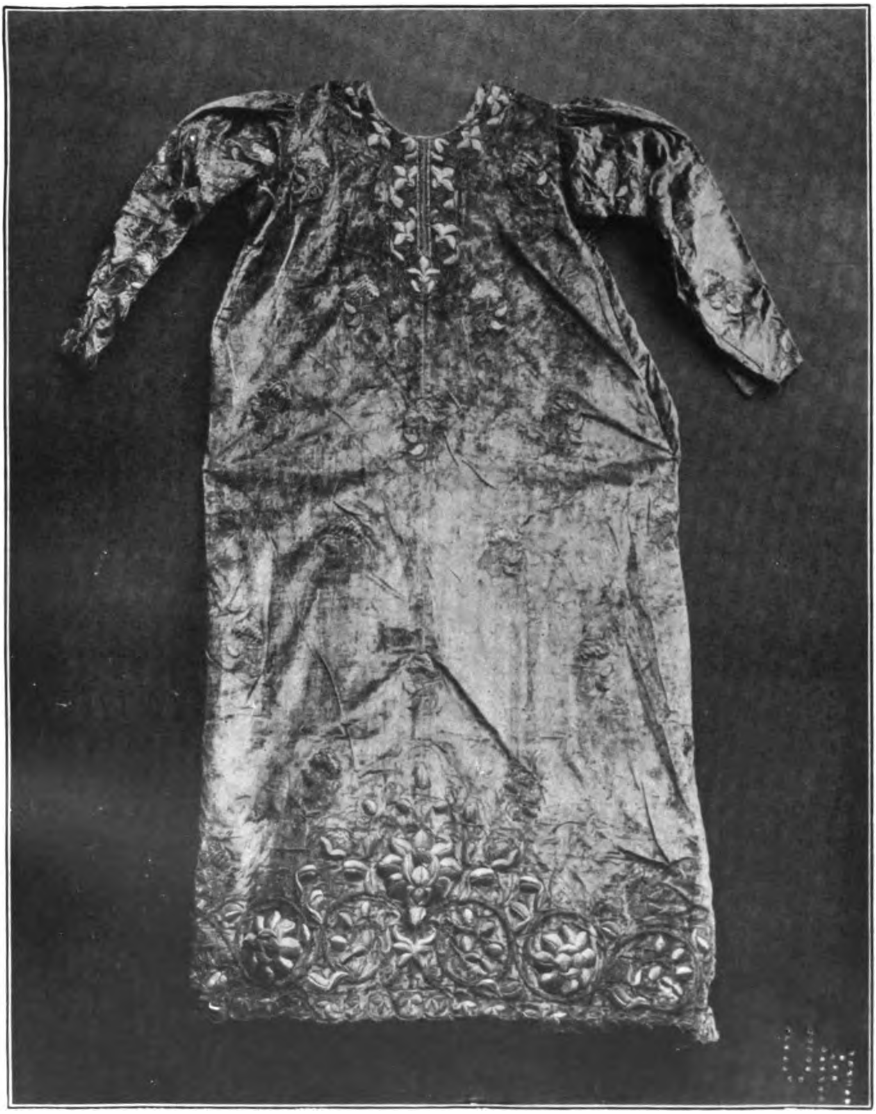
MANIPLE (1), CHASUBLE (2), AND STOLE (3).

FOR DESCRIPTION SEE PAGE 612.



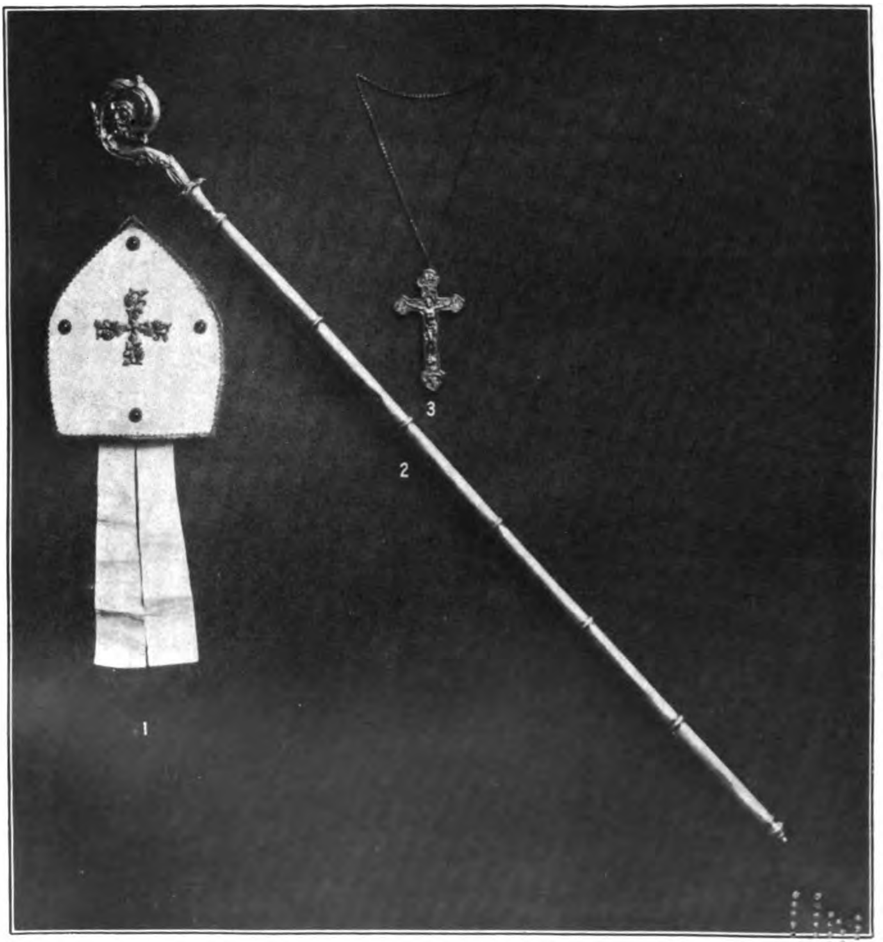
STOLE (1), CHASUBLE (2), AND MANIPLE (3).

FOR DESCRIPTION SEE PAGE 612.



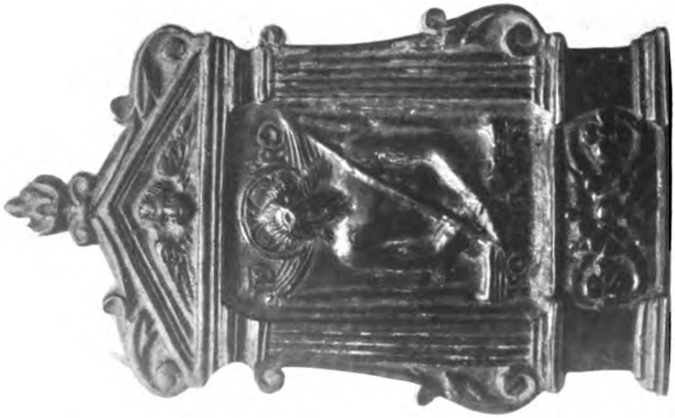
PURPLE VELVET DALMATIC FROM THE PHILIPPINES.

FOR DESCRIPTION SEE PAGE 613.



BISHOP'S MITER (1), CROZIER (2), AND PECTORAL CROSS (3)

FOR DESCRIPTION SEE PAGE 613.



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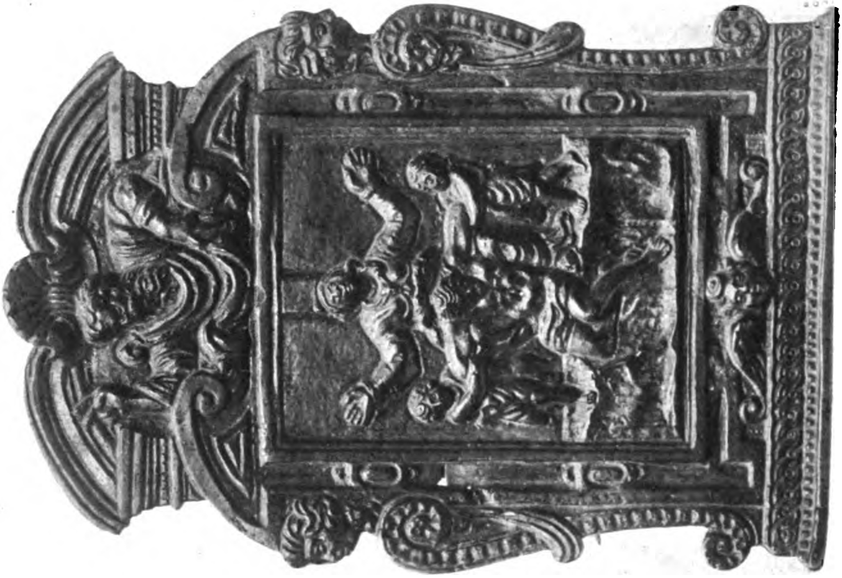
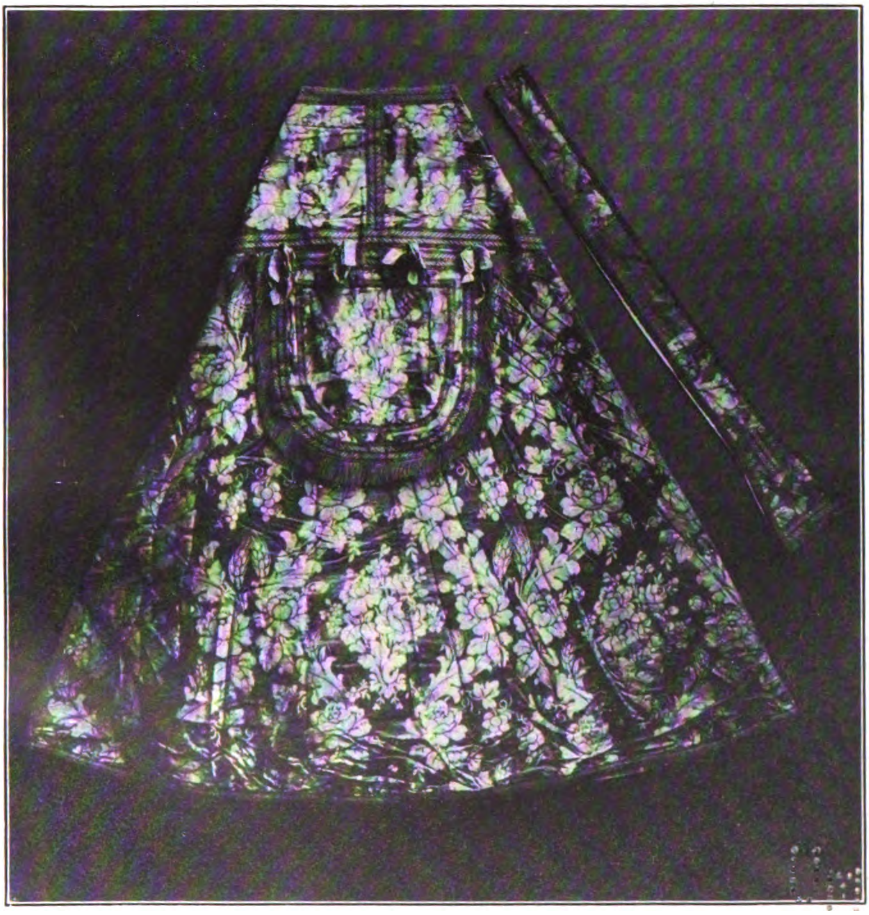


2

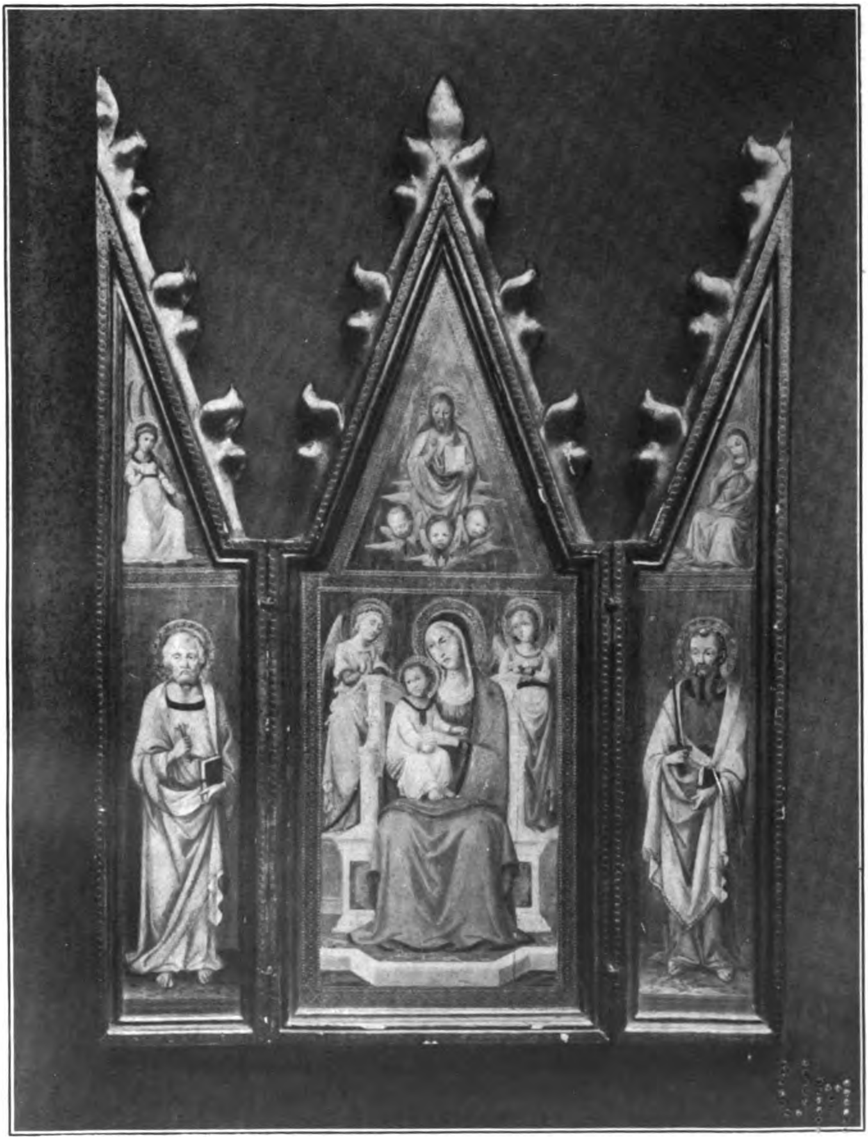
OSCULATORIES FROM ITALY.

FOR DESCRIPTION SEE PAGE 614.



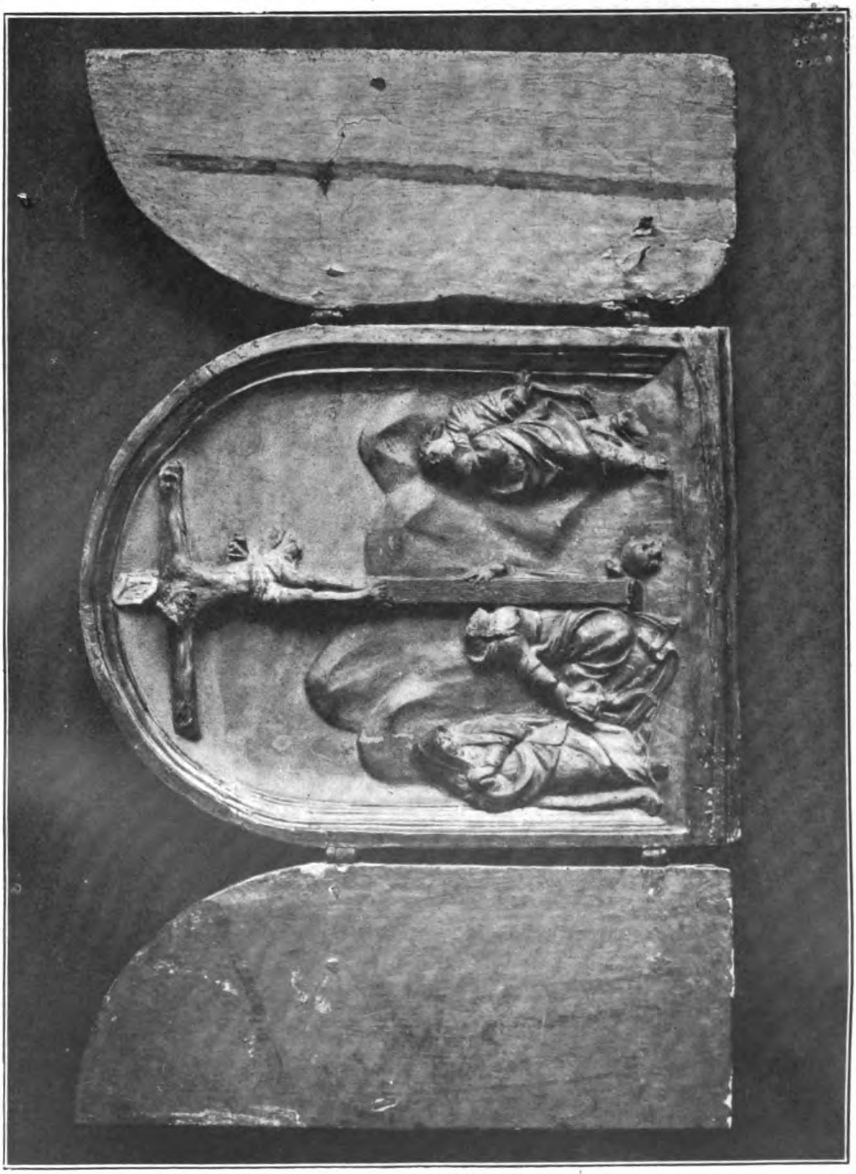
CAPE AND STOLE.

FOR DESCRIPTION SEE PAGE 615.



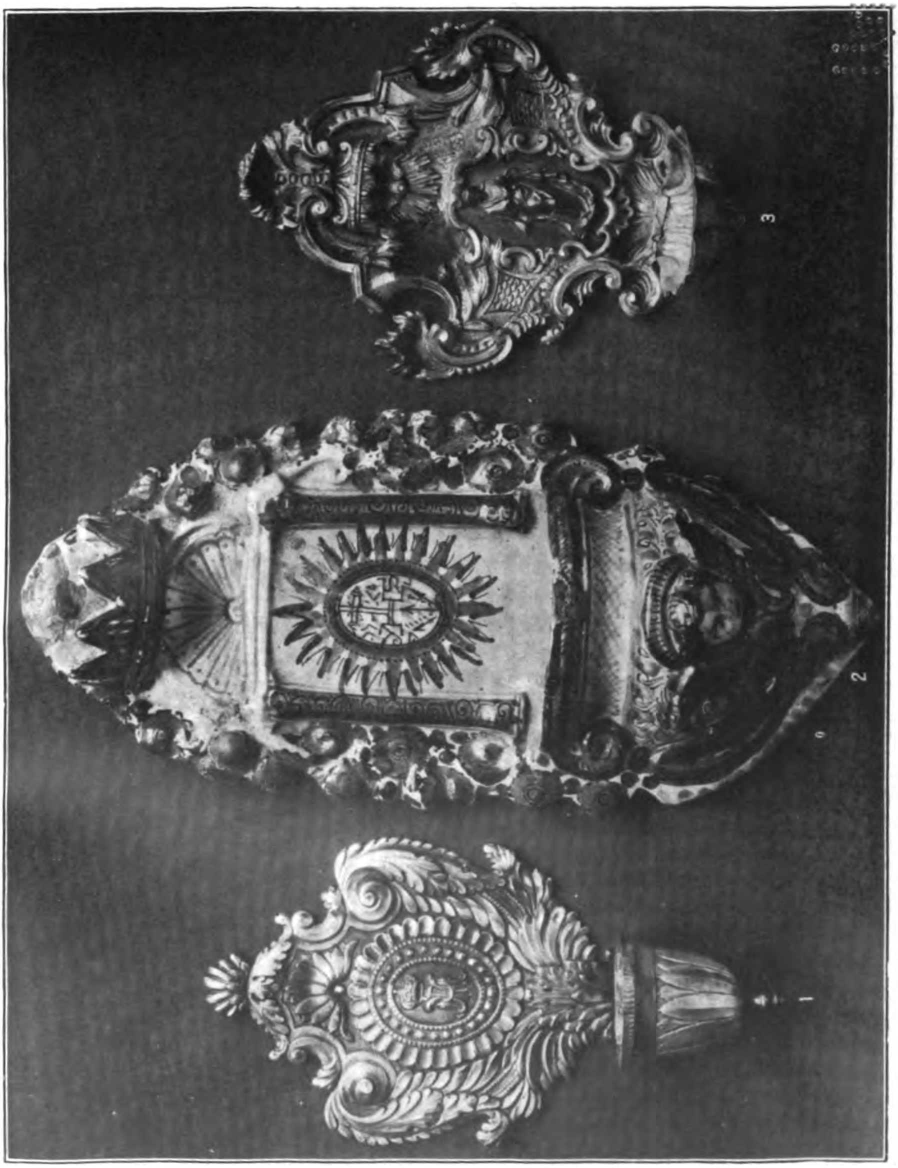
WOODEN TRIPTYCH IN GOTHIC STYLE.

FOR DESCRIPTION SEE PAGE 615.



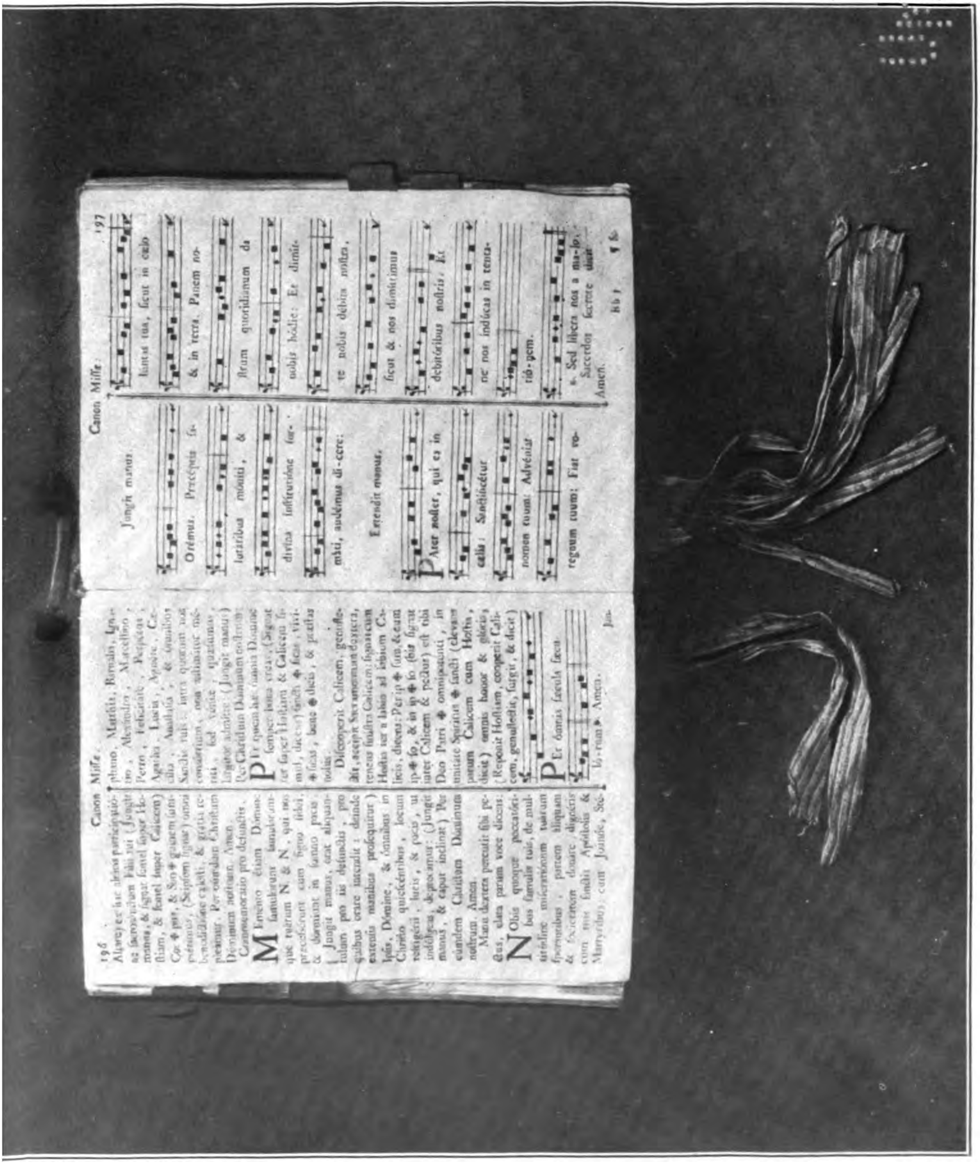
WOODEN TRIPTYCH FROM MADRID, SPAIN

FOR DESCRIPTION SEE PAGE 615



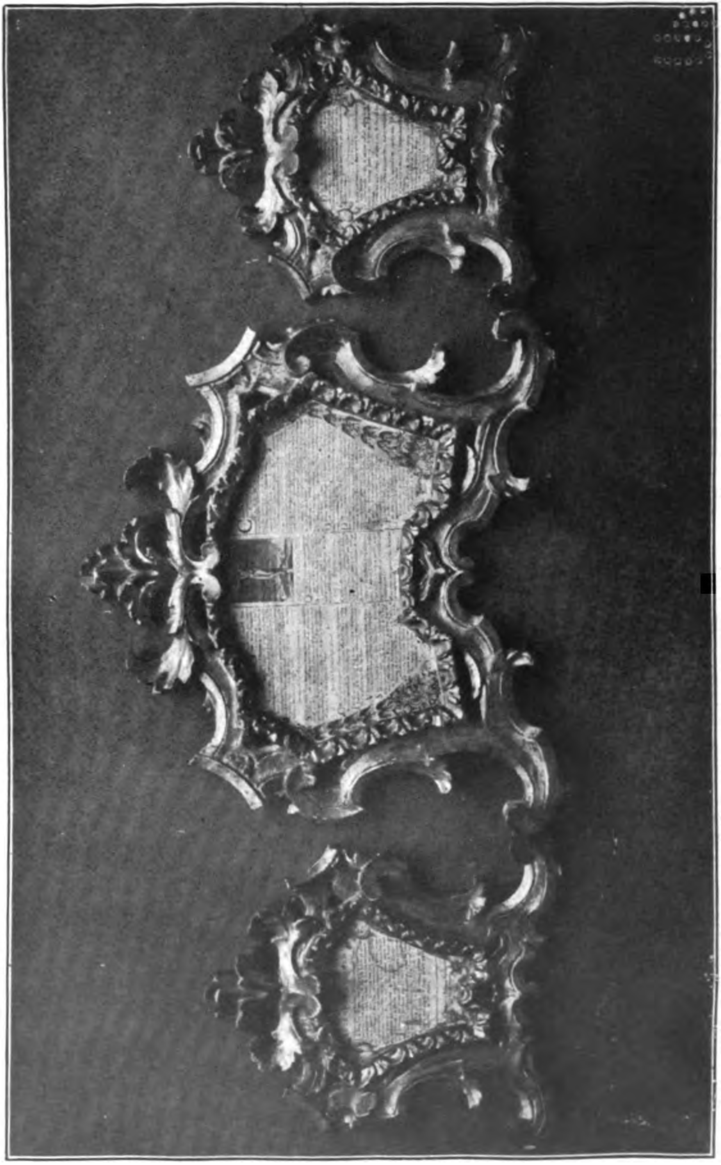
HOLY WATER FOUNTAINS FROM ITALY

FOR DESCRIPTION SEE PAGES 615 AND 616.



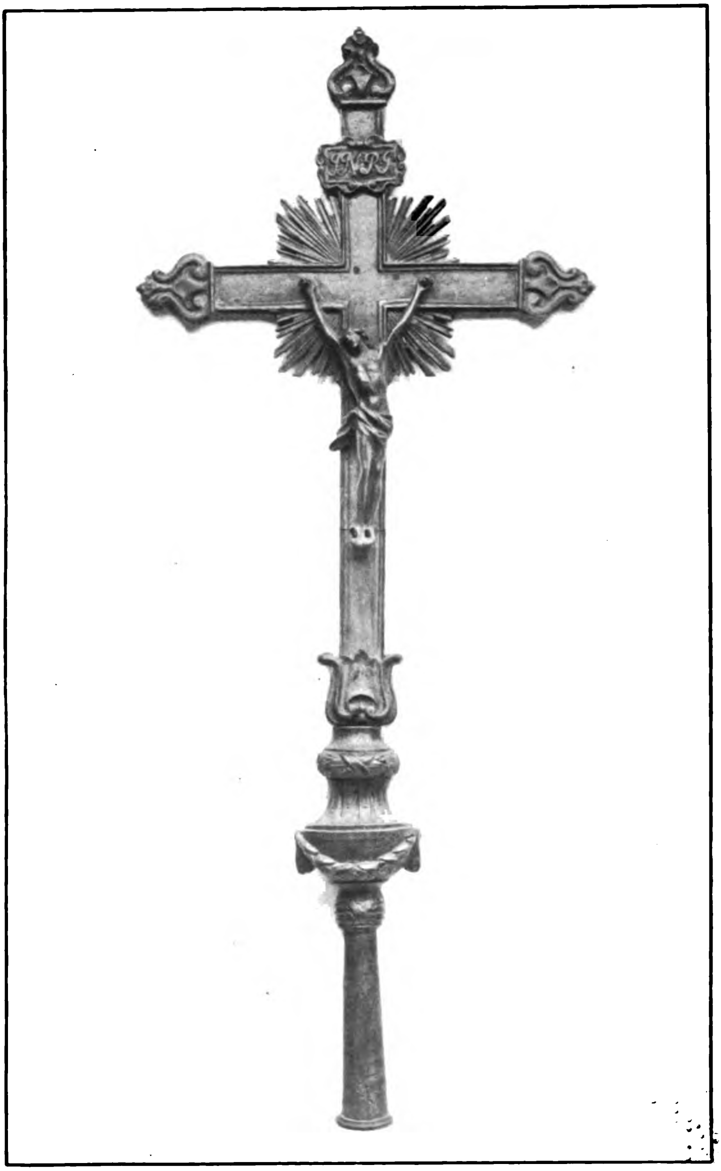
AN ITALIAN MISSAL.

FOR DESCRIPTION SEE PAGE 816.



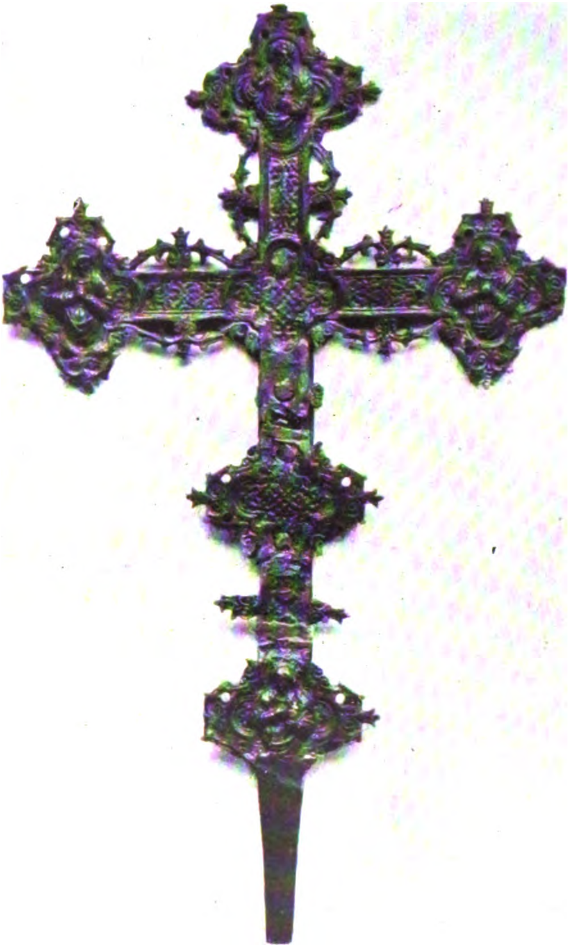
A SERIES OF ALTAR CARDS FROM ITALY.

FOR DESCRIPTION SEE PAGE 616.



PROCESSIONAL CROSS FROM MEXICO.

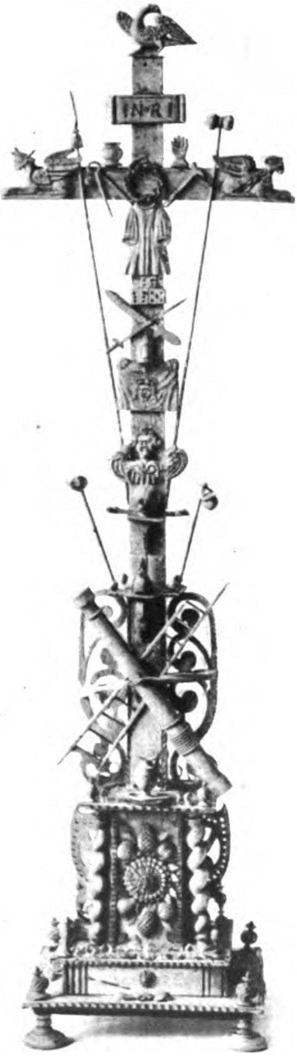
FOR DESCRIPTION SEE PAGE 618.



PROCESSIONAL CROSS FROM ITALY.

FOR DESCRIPTION SEE PAGE 618.

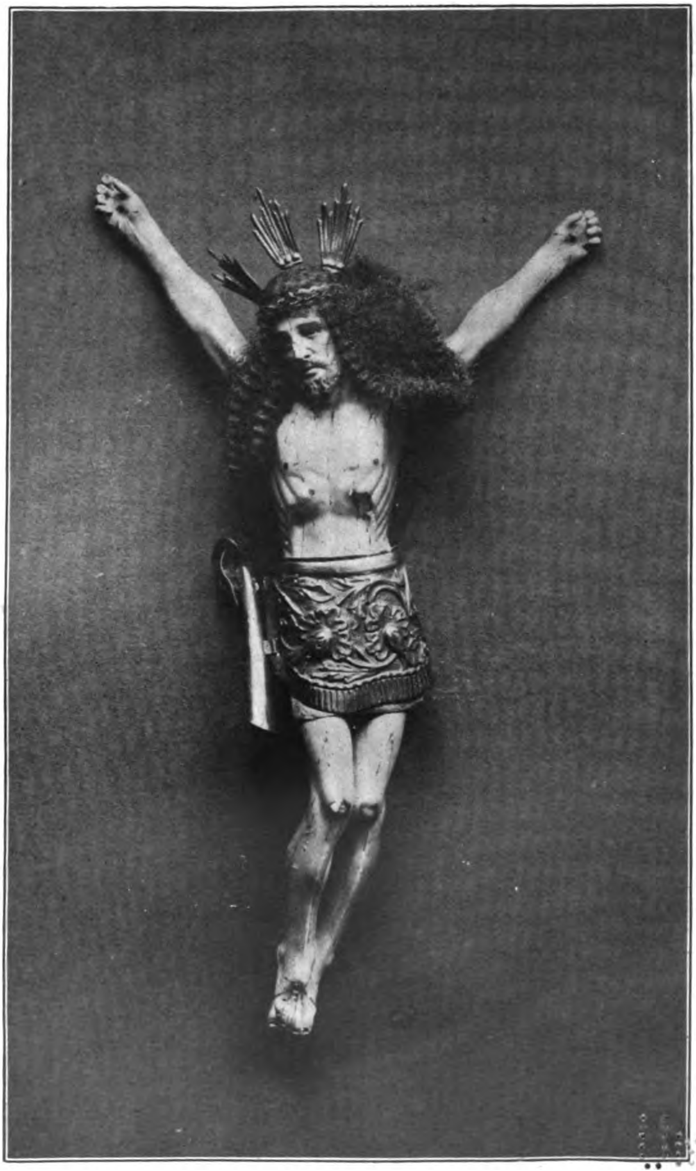
MU



IVORY CROSS WITH APPURTENANCES OF THE PASSION.

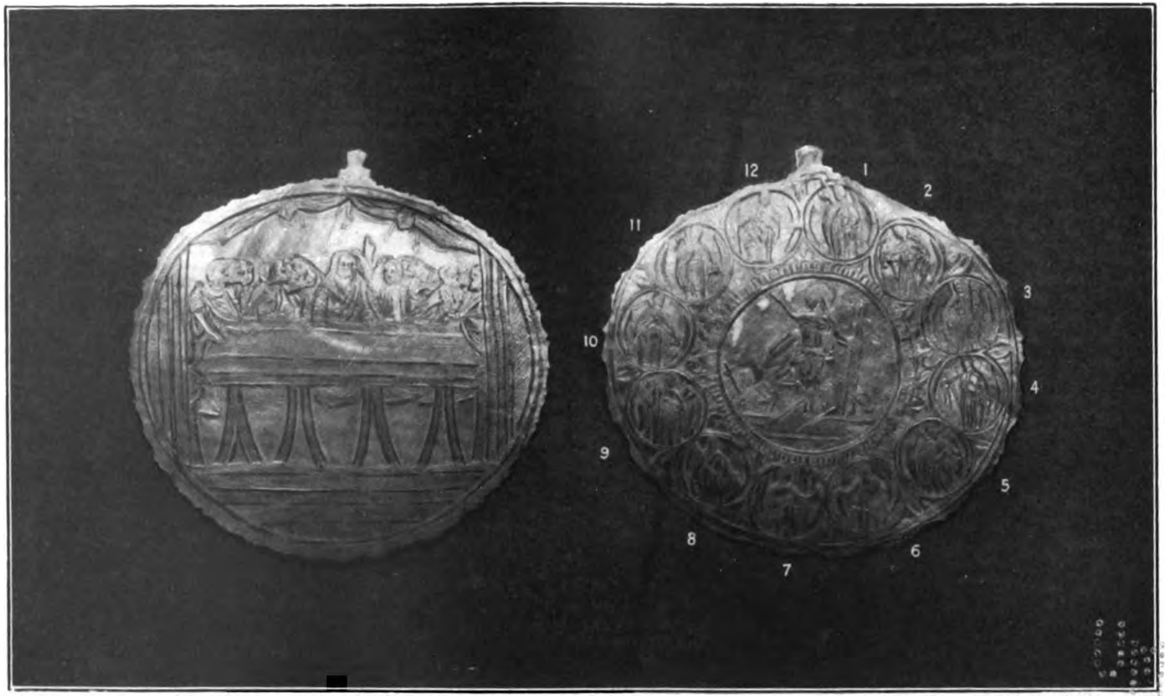
FOR DESCRIPTION SEE PAGE 619.

MU



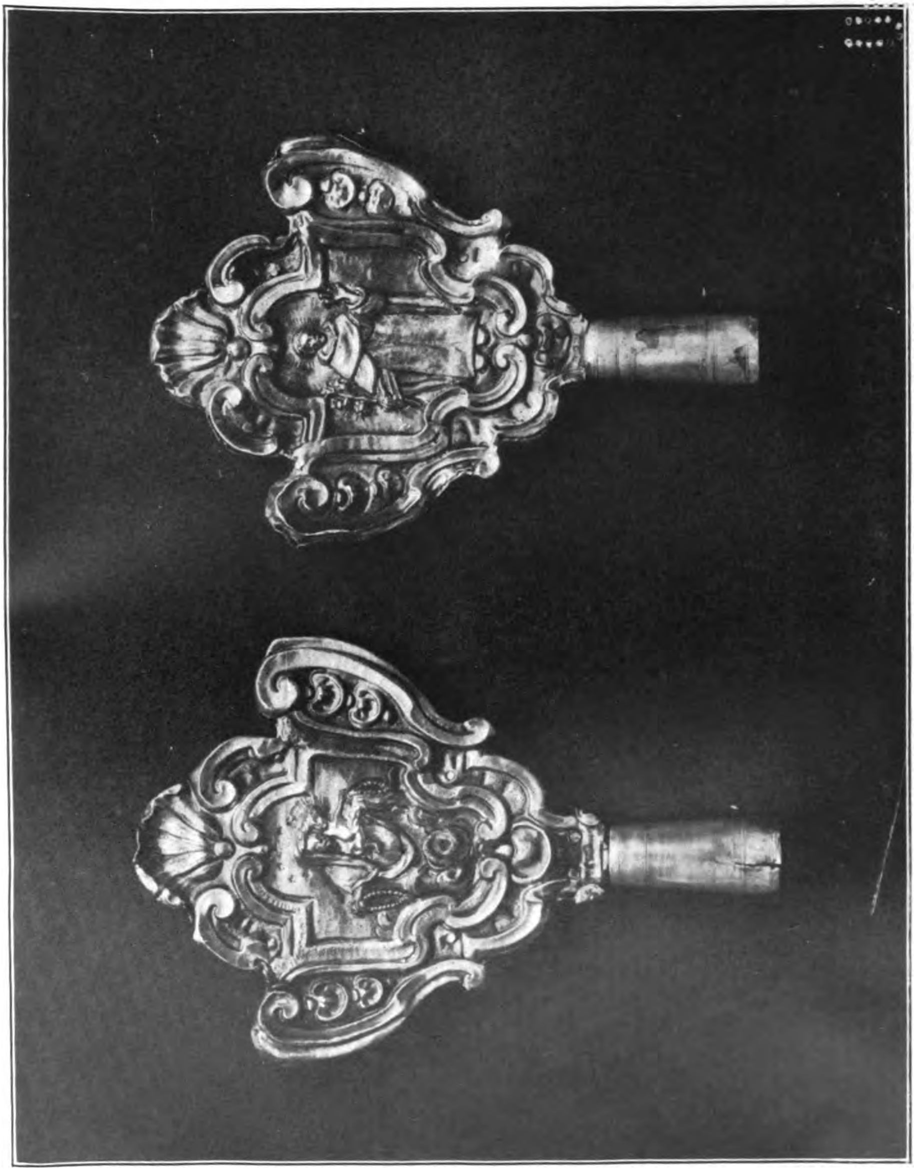
WOODEN FIGURE OF CHRIST FROM THE PHILIPPINES.

FOR DESCRIPTION SEE PAGE 622.



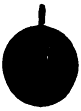
ENGRAVED SHELLS SHOWING THE LORD'S SUPPER AND THE ASCENSION

FOR DESCRIPTION SEE PAGE 623.



Processional Banners Made of White Metal.

For description see page 624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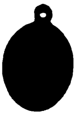
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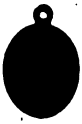
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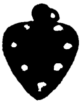
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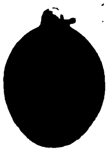
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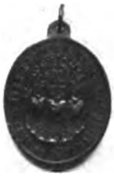
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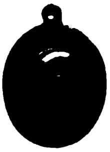
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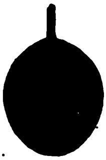
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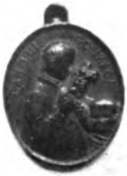
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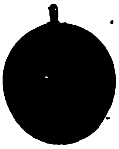
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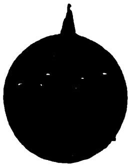
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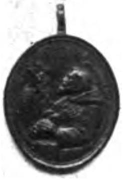
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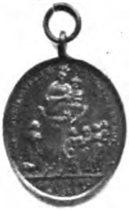
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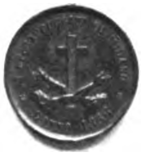
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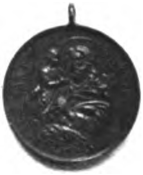
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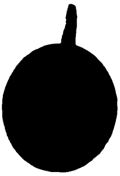
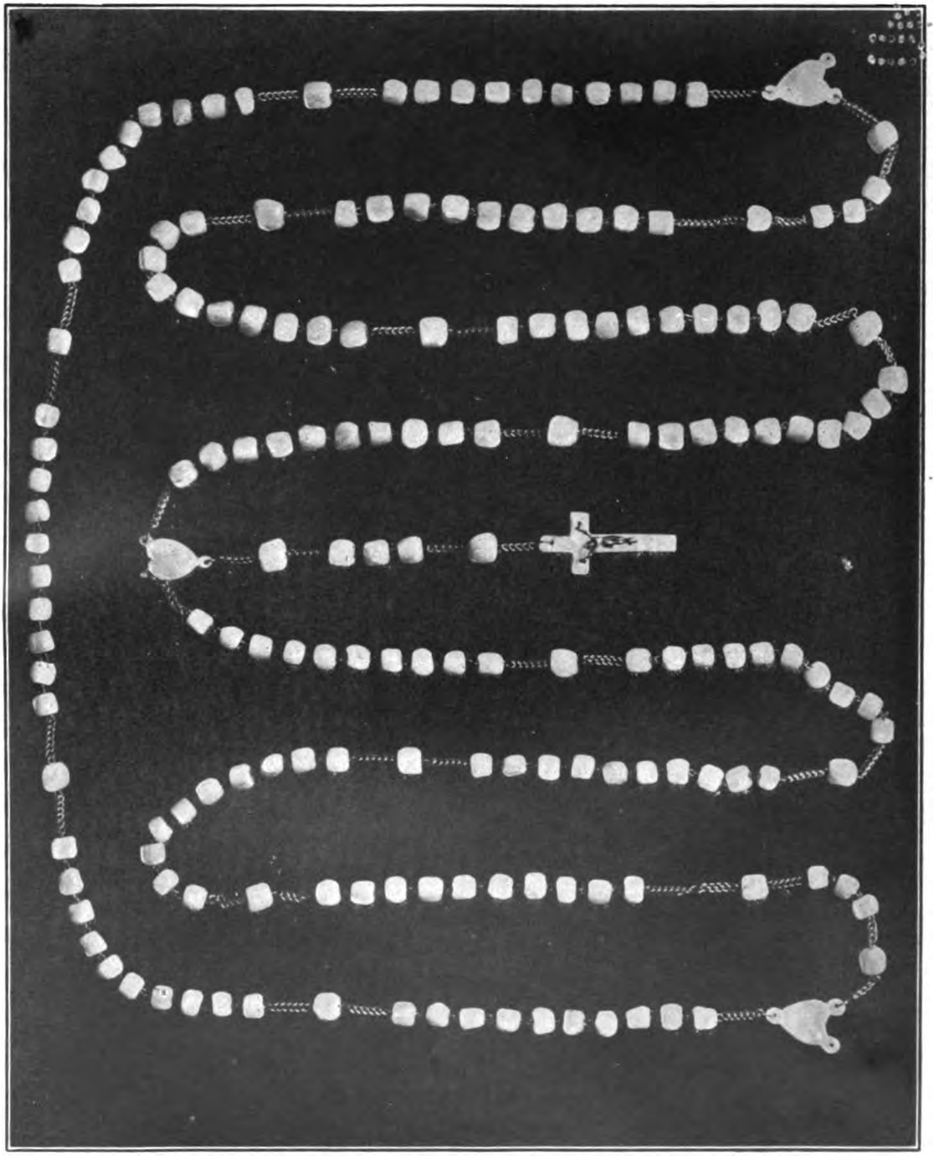

16

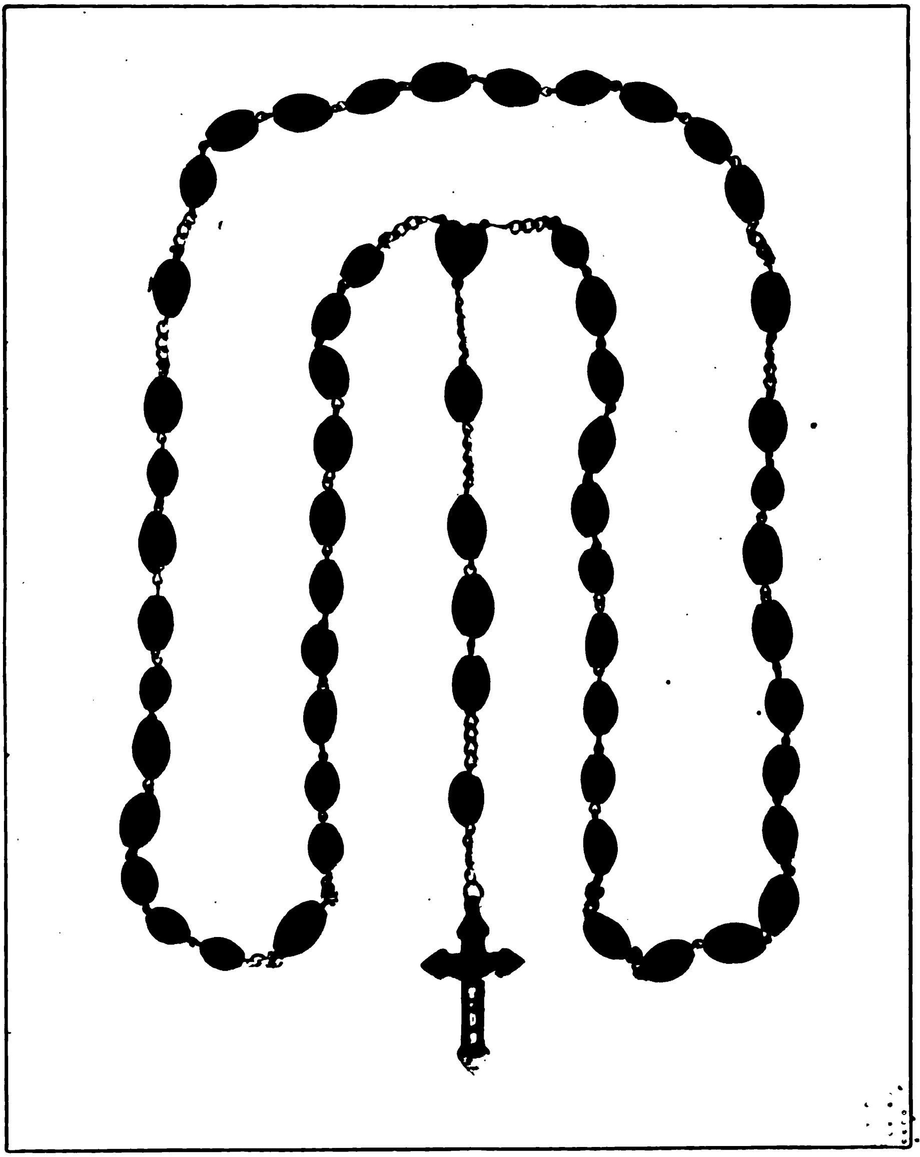
RELIGIOUS MEDALS FROM ITALY.

FOR DESCRIPTION SEE PAGE 829



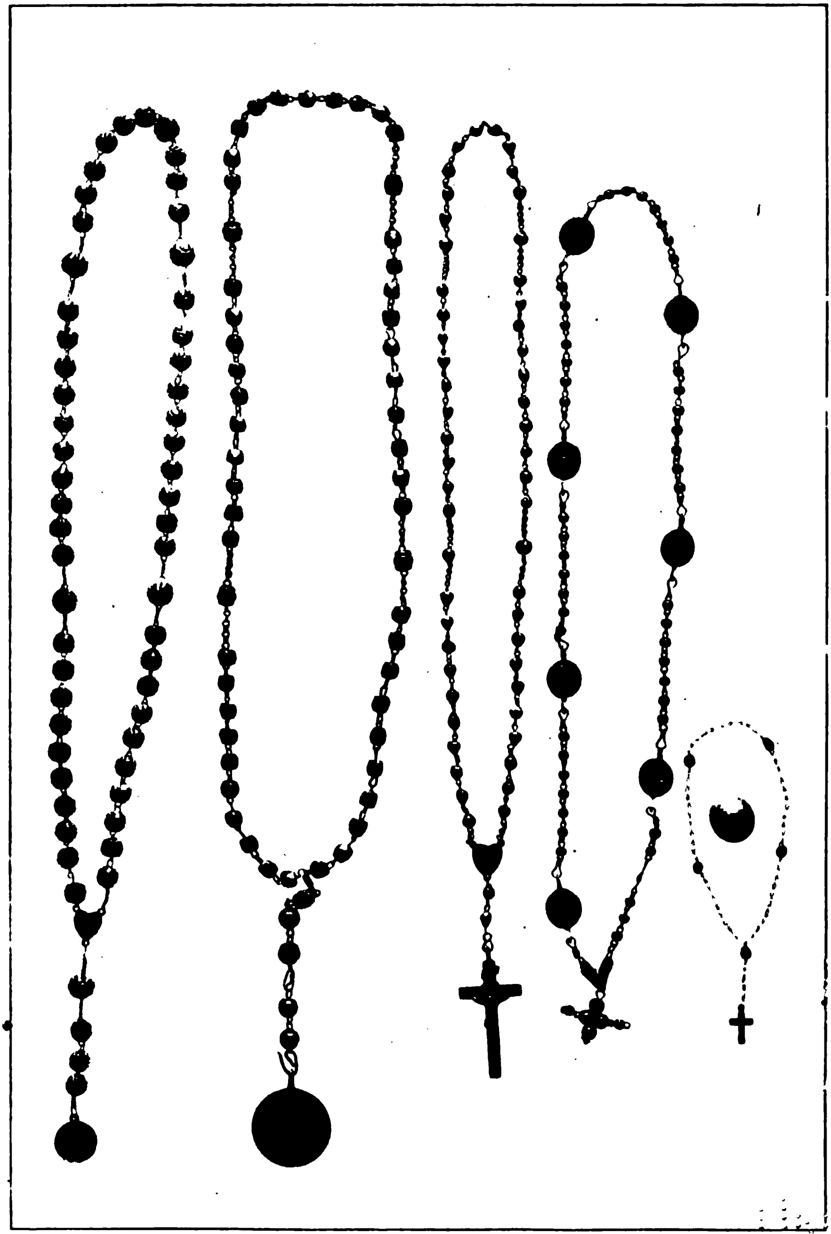
ROSARY OF MOTHER-OF-PEARL

FOR DESCRIPTION SEE PAGE 831.



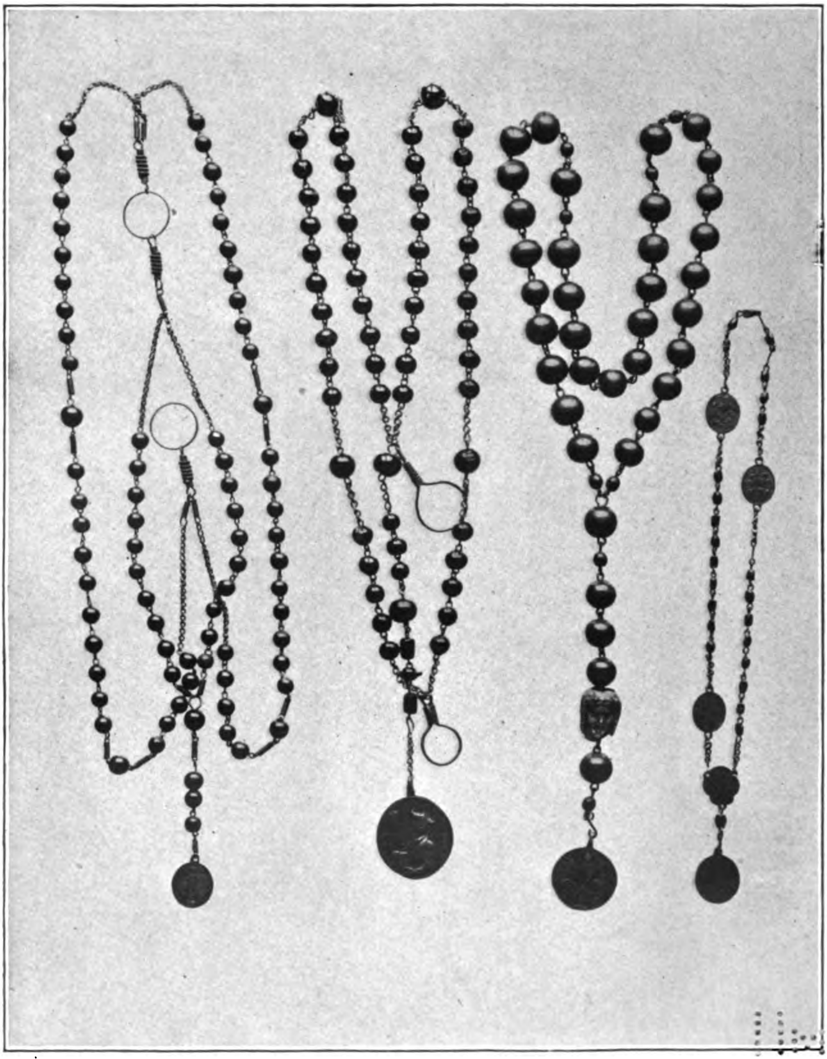
ROSARY MADE OF SEEDS OF THE VIRGINIA FRINGE TREE.

FOR DESCRIPTION SEE PAGE 631



ROMAN CATHOLIC ROSARIES.

FOR DESCRIPTION SEE PAGES 632 AND 633.



ROMAN CATHOLIC ROSARIES.

FOR DESCRIPTION SEE PAGES 633 AND 634.

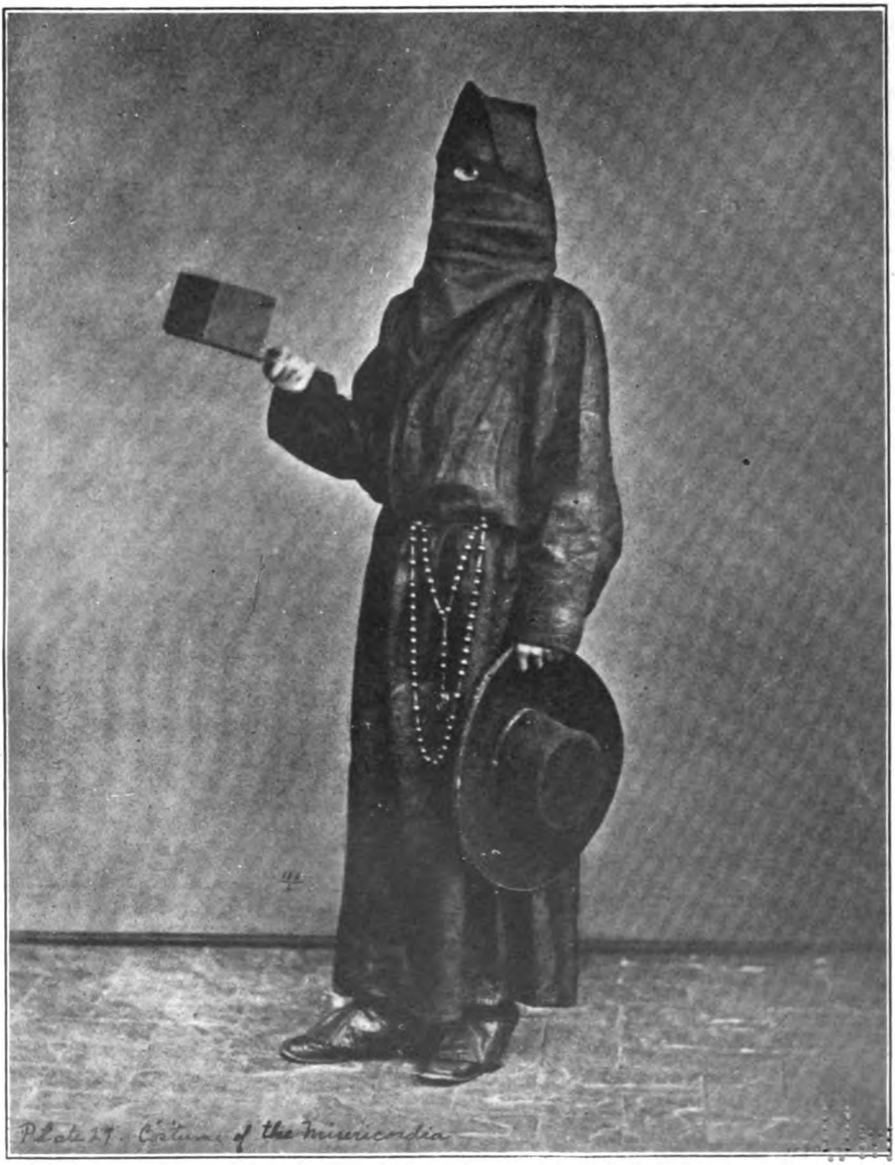
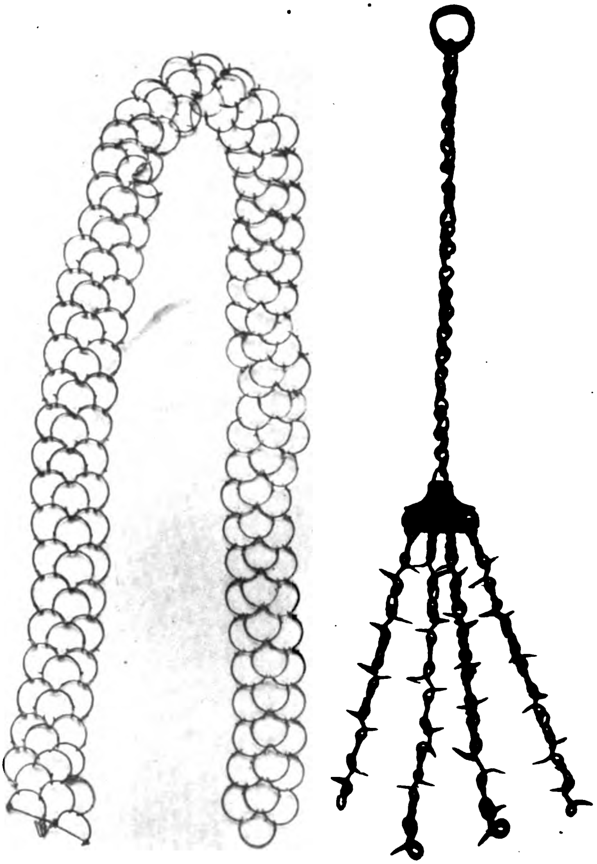


Plate 27. Costume of the Misericordia

COSTUME OF THE FRATERNITY OF THE MISERICORDIA.

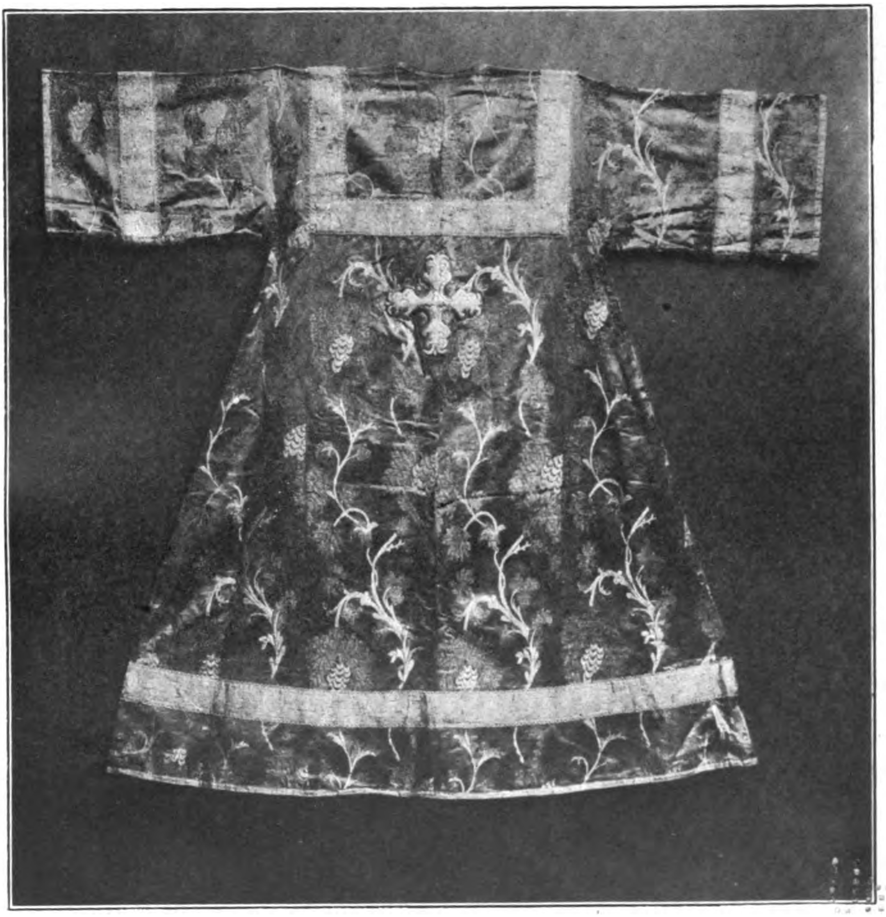
FOR DESCRIPTION SEE PAGE 634.



1 2

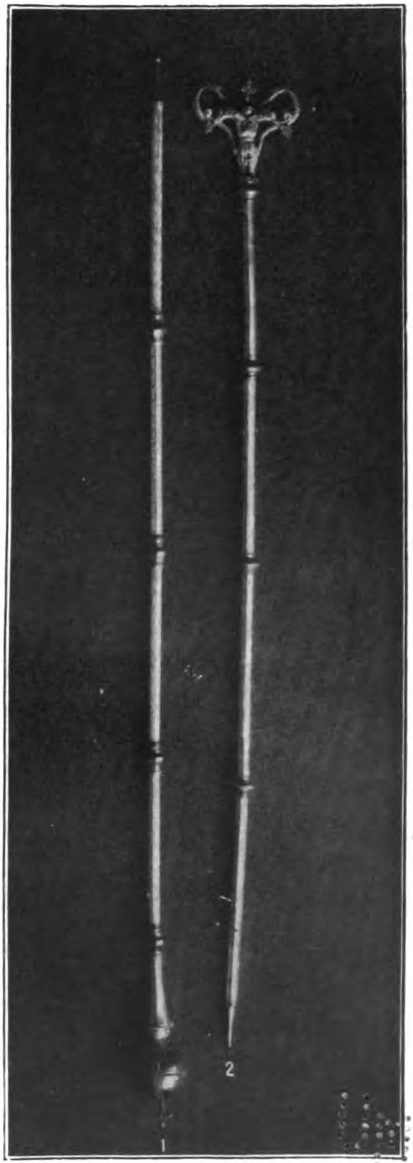
DISCIPLINARY GIRDLE (1) AND DISCIPLINARY SCOURGE (2).

FOR DESCRIPTION SEE PAGE 635.



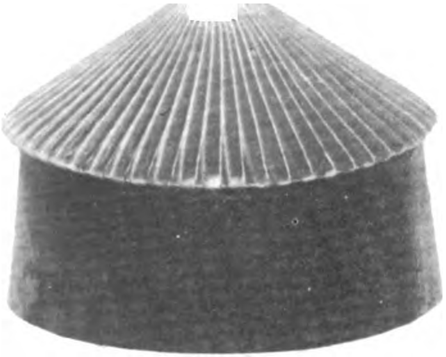
GOLD BROCADE PHAENOLION OF A RUSSIAN PRIEST

FOR DESCRIPTION SEE PAGE 642.



PASTORAL STAFFS.

FOR DESCRIPTION SEE PAGES 842 AND 846.



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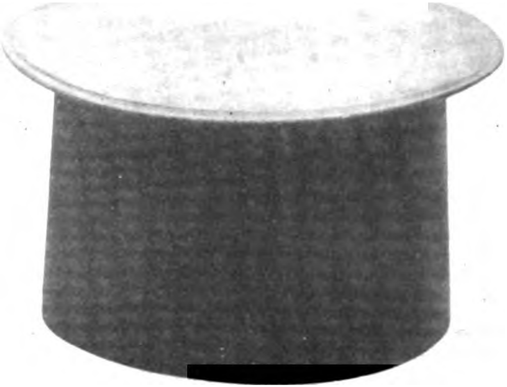
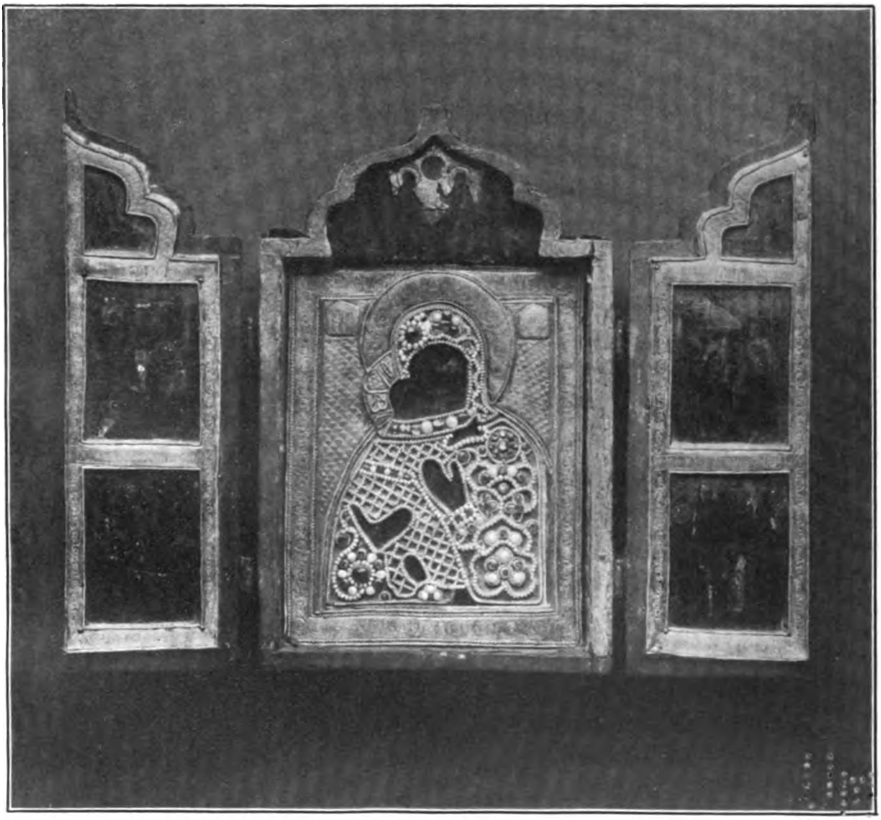


2

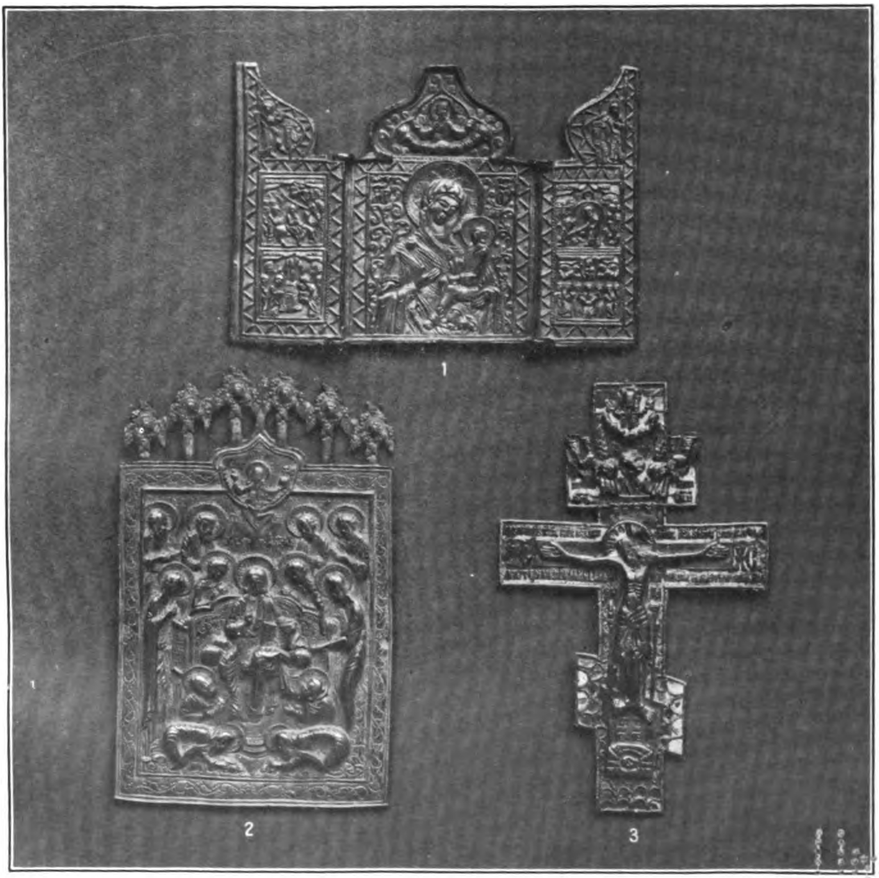
HEADGEAR WORN BY PRIEST.

FOR DESCRIPTION SEE PAGES 635 AND 646.



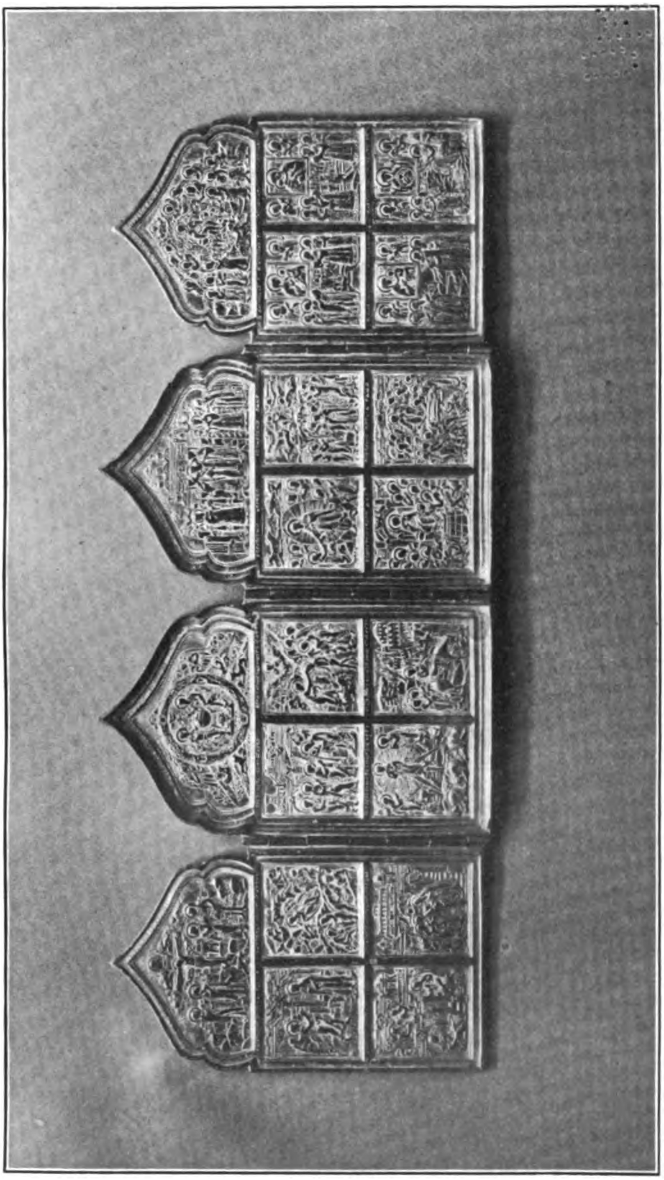
RUSSIAN ICON OF MARY AND INFANT.

FOR DESCRIPTION SEE PAGE 643.



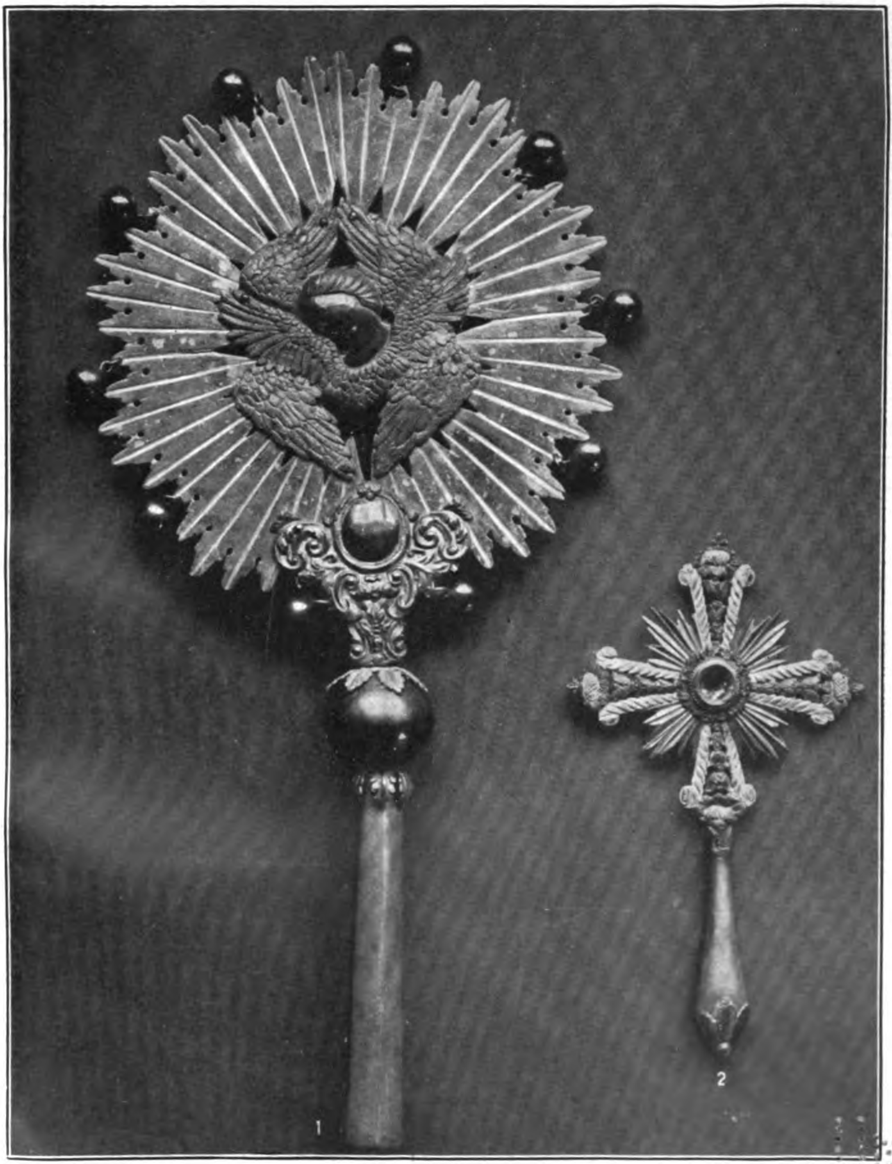
BRASS ICONS OF THE RUSSIAN CHURCH

FOR DESCRIPTION SEE PAGE 644.



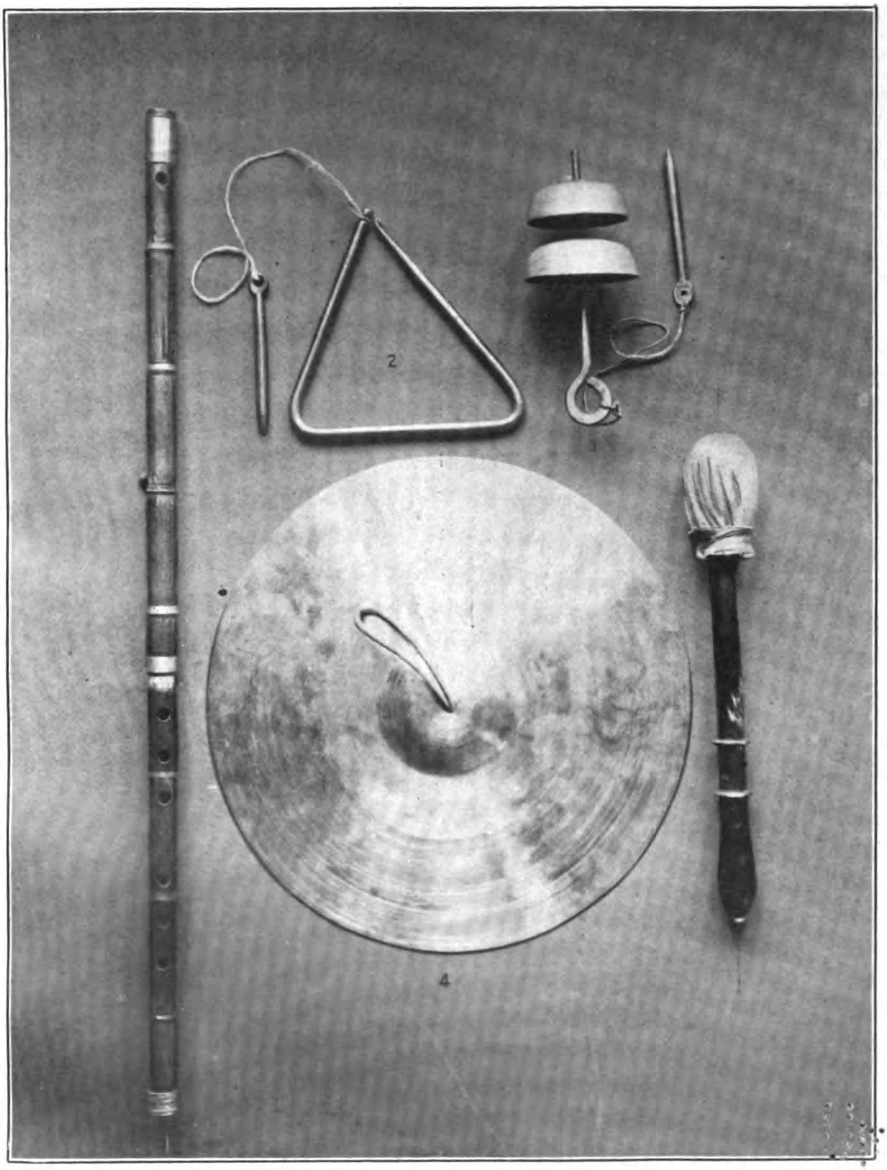
Brass Tetraptych of the Russian Church.

For description see page 644.



PARAPHERNALIA OF THE ARMENIAN CHURCH.

FOR DESCRIPTION SEE PAGE 647.



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